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Service and Regulatory Announcements, April-June 1939.—*S.R.A., B.E.P.Q.* no. 139 pp. 55–95. Washington, D.C., U.S. Dep. Agric., 1939.

Existing methods authorised for the treatment of sand, soil, earth, peat, compost, manure, nursery stock, fruits and vegetables for the elimination of the Japanese beetle [*Popillia japonica,* Newm.] under regulations of Quarantine no. 48 are revised and consolidated in Administrative Instructions (B.E.P.Q. 499). Information is given on the required grades of the authorised chemicals and precautions to be exercised in using them. The methods for fumigating potting soil with carbon bisulphide and naphthalene, fumigating shipments of sand, soil, earth, peat, compost and manure with carbon bisulphide, fumigating soil in and around cold frames, plunging beds and heeling-in areas with carbon bisulphide and naphthalene and treating it with carbon bisulphide emulsion, removing soil from about the roots of plants after digging, treating plants after digging with hot water and carbon bisulphide emulsion dip and fumigating them with paradichlorobenzene by complete coverage, fumigating plants with or without soil with methyl bromide, and, in the case of strawberry plants, fumigating in shipping crates of field-packed baskets, fumigating fruit with carbon bisulphide, ethylene oxide, liquid hydrocyanic acid or 88 per cent. calcium cyanide, and fumigating commodities in refrigerator cars with methyl bromide have already been noticed [*R.A.E.*, A **18** 354; **20** 104; **22** 571; **24** 258; **26** 384; **27** 591].

Directions are also given for various other treatments. Friable potting soil, shipments of sand, soil, earth, peat, compost and manure, and soil in hot-beds may be treated by heating throughout to 130°F. and maintaining this temperature for 30 minutes. An alternative method of fumigating potting soil with carbon bisulphide [**18** 354] is to fill the receptacle with soil and then make holes from the surface to different levels so that the carbon bisulphide is applied in the same positions as by the first method. The liquid must be poured into the deep holes through a tube or injected. Potting soils that are friable and not wet may be treated with acid lead arsenate at the rate of 2 lb. per cu. yard, thoroughly mixed with the soil. The treatment is recommended only for soils that are slightly acid or neutral in reaction. Plants potted in soil so treated by 1st August may be certified between 1st October and 15th June following. When plants so treated are plunged in beds or frames exposed to infestation, the soil in the beds or frames must previously have been treated with lead arsenate at the rate of 1,500 lb. per acre. Soil in and around cold frames, plunging beds, etc., must be treated with lead arsenate except when the use of heat, carbon bisulphide, carbon bisulphide emulsion or naphthalene is authorised. Lead arsenate should be applied to friable soil in good tilth at the rate of 35 lb. per 1,000 sq. ft. or 1,500 lb. per acre, thoroughly mixed and incorporated with the upper 3 ins. of soil. It should be applied before 1st August if the land is to be used in the autumn, and plants must not be placed on or in the soil until after 1st October.

For the treatment with paradichlorobenzene of soil about the roots of plants after digging, a side application method in which the fumigant is not permitted to come within 2 ins. of the stem may be used in addition to the complete coverage method already noticed. The various combinations of dosage and exposure that may be used at different temperatures are given in a table. When complete coverage is used, the soil should contain 6 oz. paradichlorobenzene per cu. ft. for treating soil balls up to 6 ins. in diameter, or 12 oz. per cu. ft. for those between 6 and 8 ins. in diameter [*cf.* **24** 258; **26** 384]. Plants may be treated before digging with carbon bisulphide emulsion [*cf.* **20** 681] provided that adult beetles are not present. The plants must be dug within 3 days of the completion of the treatment. Tables show the dosage of stock emulsion to be applied according to the temperature of the soil for various sizes of circular and square collars. That for square collars should be followed for the treatment of soil in cold frames, etc. Plants may also be treated before digging with lead arsenate before 1st July for certification from the completion of treatment until 15th June following. The soil must be friable and in good tilth, and the treatment is recommended only for soils that are slightly acid or neutral in reaction. The conditions are the same as those for the treatment of soil in cold frames, etc. Plants in plots treated initially must not be dug until 1st October, those on re-treated plots may be dug on 20th September.

Cyanide fumigation of bananas and empty refrigerator cars may be carried out with HCN discoids at 6·5 oz. HCN per car as well as with liquid hydrocyanic acid or 88 per cent. calcium cyanide [**22** 571]. Detailed instructions are given for the fumigation with methyl bromide [**26** 751] of potatoes, sweet potatoes, onions, tomatos, snap beans, lima beans, sweet maize, cabbage, carrots, beet, apples and peaches in refrigerator cars and in approved fumigation chambers.

In an announcement (B.E.P.Q. 496) relating to Quarantine no. 72 [**27** 274] against the white-fringed beetle [*Naupactus leucoloma*, Boh.], suggestions are made for constructing plunging and growing beds in such a way as to prevent natural infestation by this weevil. Raised plunging beds that are at least 12 ins., and preferably 18, above the ground and are protected by oil or other barriers, and heeling-in areas or growing grounds enclosed within walls that extend far enough underground to prevent larvae from passing underneath and are high enough to permit the construction of oil or other barriers 12 or preferably 18 ins. above the ground are considered suitable.

Plant quarantine import restrictions in the Territory of New Guinea are summarised, import restrictions in Venezuela are translated, and supplements are given to restrictions already noticed from Malta, Eire (Irish Free State), Finland, Rumania, St. Lucia, Persia (Iran), the Union of South Africa and Australia.

HILDEBRAND (A. A.). **Notes on Mealy Bug Injury on Strawberry and its Resemblance to Crinkle.**—*Canad. J. Res.* (C) **17** no. 7 pp. 205–211, 4 figs., 9 refs. Ottawa, 1939.

Symptoms that were tentatively attributed to crinkle disease [*cf. R.A.E.*, A **27** 395], which has not occurred in Ontario, but has been reported from the north-western United States, England and Australia, appeared intermittently on strawberry plants in a greenhouse in Ontario for several years during investigations on virus diseases, and in 1938 mealybugs (*Pseudococcus*) were observed among the leaf bases, on petioles and peduncles and within the folded leaves of affected plants. Circumstantial evidence indicated a correlation between the symptoms and the presence of the mealybugs, since the affected plants generally occurred in groups, and when 120 affected and 542 healthy plants were examined on 9th June, mealybugs were found on 83·3 per cent. of the former, but on only 4·5 per cent. of the latter.

When mealybugs were transferred in June to 20 healthy plants, comprising *Fragaria virginiana* and two commercial varieties of strawberry, typical symptoms appeared in all the plants, but were confined to the young leaves that unfolded after the transfer. They were observed as early as four days after infestation, but the time required for their appearance depended on the stage of development of the young leaves. No varietal differences in susceptibility were observed. On 15th July, half the artificially infested plants were fumigated with calcium cyanide and sprayed with water until free from insects ; at the end of August these had recovered and appeared to be normal, whereas two of the untreated plants had died and the others displayed characteristic dwarfing and chlorosis. In experiments in which mealybugs were confined by means of Van Tieghem cells to limited areas on the upper or lower surface of the leaves or on the petioles, the characteristic translucent spots on the leaves appeared only in cases in which the insects had been confined to the lower surface of recently unfolded leaves. The fact that they did not appear as a result of infestation of the petioles showed that they were due to feeding punctures on the young leaves and not to systemic infection following the injection of some toxic or other principle. In no case throughout the investigation were the mealybugs observed to feed on the laminae of older leaves.

The symptoms of crinkle disease and of injury by the mealybugs are compared. Both result in the development on the young unfolded leaves of chlorotic areas, which enlarge with the growth of the foliage and produce a stippled effect in the former and a mottled or mosaic effect in the latter, and in ultimate dwarfing. On plants injured by mealybugs, however, the more intensely chlorotic spot in the middle of the translucent area does not generally become reddish and necrotic, the veins do not become clear and the leaves of heavily infested plants, although distorted, do not become rugose.

Mealybugs were not observed on strawberry plants out of doors, and since strawberries are rarely grown commercially under glass, they are not of economic importance in crop production. In view of the large numbers of plants grown in greenhouses for experimental purposes, however, the present investigation was undertaken to avoid errors in diagnosis arising from the confusion of similar symptoms.

Entomology. Forest Insect Survey.—*Bull. Ohio agric. Exp. Sta.* no. 592 (Rep. 1936–37) pp. 41–53, 129–130, 3 figs. Wooster, Ohio, 1938. [Recd. 1939.]

Work on insect pests of maize in Ohio during 1936–37 is described by L. L. Huber. Differences are recorded in the average numbers of larvae of *Pyrausta nubilalis*, Hb., present in the stalks of different strains of maize before the tassels appeared [*cf. R.A.E.*, A **25** 468], and a laboratory experiment indicated that the nutritive value of the etiolated leaf tissue, on which the newly hatched larvae feed, may vary with the strain. Another experiment indicated some resistance in one group of strains to the effect of damage to the roots by larvae of *Diabrotica duodecimpunctata*, F. A bait of 5 lb. bran, 1 U.S. quart mineral oil (viscosity S.A.E. 20) and 4 oz. Paris green [*cf.* **27** 67] gave only 79 per cent. mortality of cutworms, chiefly *Euxoa messoria*, Harr., in 40 hours and in the absence of other food, whereas one in which the oil was replaced by 3 U.S. quarts water and 1 U.S. pint molasses killed 99 per cent. The molasses bait did not lose its effectiveness when allowed to dry.

R. B. Neiswander reports that damage to peach by *Cydia* (*Grapholitha*) *molesta*, Busck, varied throughout the State during 1937, but in some cases, in contrast to usual experience, was less severe on later varieties. Six colonies of *Macrocentrus ancylivorus*, Rohw., bred from *C. molesta* from northern Ohio, were liberated in localities in which this parasite was not known to be present. It is now established in south-western Ohio, where it was responsible for 95 per cent. of the total parasitism (67 per cent.) observed in twig-feeding larvae in one county. Five species of imported parasites of *C. molesta* were released in 20 counties during the season, and considerable numbers of one of them were recovered from a later generation of host larvae.

In experiments with sprays against *Cydia* (*Carpocapsa*) *pomonella*, L., on apple, C. R. Cutwright found that lead arsenate was as effective against the first generation as any other insecticide and more so than most. Nicotine sulphate with oil was effective in the later cover sprays. Owing to the cool wet weather, more injury to the foliage than usual resulted from the use of spreading agents and adhesives with arsenicals, especially when soy-bean flour was used in several applications with zinc or calcium arsenate. " Safe " calcium arsenates were as injurious as the ordinary types ; two applications of one buffered with zinc sulphate in June resulted on one variety in 60 per cent. defoliation. Three applications during June and July of synthetic cryolite combined with oil was fairly safe on foliage, but injured the fruits of several varieties.

J. P. Sleesman reports that further experiments confirmed the findings that the numbers of *Empoasca fabae*, Harr., differ greatly on different varieties of potato [**25** 468], populations being larger on early varieties than on those that mature late, and that a reduction of the lime content of Bordeaux mixture to half that of the copper sulphate resulted in an increased yield of tubers, though the spray was no more effective against the leafhopper than the standard Bordeaux [*cf.* **26** 399]. Varying the formula to apply most of the copper sulphate early in the season was also beneficial. The addition of a spreading agent to the Bordeaux mixture did not increase its effectiveness.

The results of experiments by H. L. Gui on the control of *Pieris* (*Ascia*) *rapae*, L., *Plusia* (*Autographa*) *brassicae*, Riley, and *Plutella maculipennis*, Curt., on cabbages did not conform with those of previous years [**25** 468 ; **26** 399], since the greatest yield was obtained by treatment with a mixture of 1 lb. derris dust (containing 4 per cent. rotenone) and 7 lb. talc.

C. R. Neiswander reports that adults of *Lachnosterna* (*Phyllophaga*) were abundant during 1937 after having been relatively scarce in 1935 and 1936, and the average numbers of larvae present in September in lawns sown in the spring of 1935 were 2·9, 0·3, 0·0, 0·4 and 0·4, respectively, in untreated plots and in plots in which lead arsenate at rates of 5, 10, 20 and 30 lb. per 1,000 sq. ft. had been raked into the superficial layers of soil at sowing time. *Anisolabis* (*Euborellia*) *annulipes*, Lucas, seriously damaged roots of radishes in a greenhouse in northern Ohio, but was effectively controlled by a bait of 16 lb. wheat bran, 1 lb. Dutox [barium fluosilicate and sodium fluoaluminate] and 2 U.S. quarts molasses in 2 U.S. gals. water.

J. B. Polivka reports (pp. 129–130) that in forests of pine in southern Ohio, injury caused by insects has increased of recent years, especially on trees planted before 1931. *Neodiprion lecontei*, Fitch, which was chiefly responsible for the defoliation of *Pinus echinata* that occurred throughout this region and is seldom found on other species except in mixed stands containing *P. echinata*, generally attacks small trees, but sometimes feeds on the tops of larger ones, producing the condition known as " stag head." In a small plot of *P. contorta*, fairly large trees displaying this condition were attacked by bark-beetles and finally died. The sawfly can be controlled by arsenical dusts and sprays applied as soon as the larvae appear. Small outbreaks of *N. pinetum*, Norton, occurred throughout the State during 1937, and *Anomala* (*Pachystethus*) *oblivia*, Horn, which feeds on the needles above the leaf sheath, was more numerous than in previous years. Decreased infestation by *Rhyacionia frustrana*, Comst., *R. comstockiana*, Fern., and *Dioryctria zimmermanni*, Grote [**24** 716] in 1936 compared with 1935 and 1937 is attributed to the severe winter of 1935–36 and the hot dry summer of 1936, together with considerable parasitism of the first two species. *Ips calligraphus*, Germ., *I. grandicollis*, Eichh., and *Dendroctonus terebrans*, Ol., were less numerous during 1937 except in one district where the summer was dry. When the quantities of pine slash available for breeding are small, the adults often attack living trees of low vitality. Healthy trees survive attack by *D. terebrans* if the flow of sap is sufficient to drown the beetles, but infestation by *I. calligraphus* is generally fatal.

HORSFALL (J. G.), HERVEY (G. E. R.) & SUIT (R. F.). **Dwarfing of Cucurbits sprayed with Bordeaux Mixture.**—*J. agric. Res.* **58** no. 12 pp. 911–927, 7 figs., 10 refs. Washington, D.C., 1939.

Bordeaux mixture, which is often recommended for use on cucurbits as a repellent for cucumber beetles [*Diabrotica* spp.], is responsible for injury with six distinct symptoms of which two, dwarfing and leaf deformation, are dealt with in this paper. The effect of the three components of Bordeaux mixture and of the spray load and the hydrogen-ion concentration were studied in New York State in 1936–38. The basic cause of dwarfing is discussed, and it is suggested that it may be due to physiological drought in the tissues induced by the effect of Bordeaux mixture on transpiration, to the action of calcium ions in hardening the tissues, to reduced photosynthesis, or to a combination of these causes.

WATSON (J. R.). **Control of four Household Pests.**—*Pr. Bull. Florida agric. Exp. Sta.* no. 536, 2 pp. Gainesville, Fla., 1939.

The pests dealt with are cockroaches, rats, bed-bugs and the plaster bagworm, *Tineola walsinghami*, Busck. This Tineid, which is stated in the literature to feed on the dried remains of insects in spiders' webs, has attracted attention during the last few years in houses in southern Florida, where it feeds readily on woollen goods of all kinds. On rugs and carpets, it may be controlled by dusting the underside with fresh pyrethrum powder, which should be left for 2–3 days. Undiluted kerosene is effective and can be used on woodwork and floors that will not stain. On curtains, etc., pyrethrum in a more highly refined oil may be used. An effective and economical spray that will not stain is made by adding 1 lb. fresh pyrethrum powder containing 1 per cent. pyrethrins to 1 U.S. gal. water-white kerosene and filtering after 24 hours.

BARTLETT (K. A.). **The second Introduction of the Amazon Fly from British Guiana into Puerto Rico.**—*Agric. Notes Puerto Rico Exp. Sta.* no. 86, 4 pp., 3 refs. Mayaguez, P.R., 1938. [Recd. 1939.]

In September 1937, the author collected a stock of *Metagonistylum minense*, Tns., in British Guiana for introduction into Porto Rico for the control of *Diatraea saccharalis*, F., on sugar-cane, as a previous introduction [*R.A.E.*, A **25** 414] had not resulted in its establishment. At least 25 per cent. of the *Diatraea* larvae collected were parasitised [*cf.* **26** 491], but a definite figure was not readily obtained. The only parasites reared in addition to *M. minense* were four individuals of *Ipobracon* sp. A shipment of 120 puparia and 53 adults of *M. minense* was sent by air express from British Guiana to Porto Rico on 25th September. Of the adults, 43 reached Porto Rico alive, and 7 of these were mated females, which were retained for breeding. The author took 284 puparia and 57 adults on his return by air on 3rd October, and an additional shipment of 202 puparia was received on 10th October. The last two batches of puparia were obtained from 1,219 artificially infested hosts. Larvae were dissected from mated females of *M. minense* that had completed a 7-day gestation period, and transferred with a camel's-hair brush to caterpillars of *Diatraea* that had been immersed in a 0·1 per cent. saline solution. The caterpillars were then placed in cavities made in 8-inch lengths of sugar-cane shoot, and the cane shoots were kept in bundles of 10 in galvanised iron cylinders completely closed except for a ventilation hole 2 ins. in diameter covered with fine mesh wire, and having a layer of shredded bagasse on the bottom. After 12 days, the parasite puparia were removed and placed in moist bagasse in another container for emergence. Each small *Diatraea* larva received one, and each large one, two parasite larvae. At the time of writing, *M. minense* was being reared in the laboratory in Porto Rico and liberated extensively, and had been recovered in a number of collections near points of liberation.

Infestation of sugar-cane by *Sipha flava*, Forbes, in British Guiana was observed to be correlated with poor drainage, and the leaves of the cane were covered with black fungus growing on the honey-dew excreted by the Aphids. Various Coccinellids attack them in British Guiana, but the only two of importance are *Cycloneda sanguinea*, L., and *Scymnus phloeus*, Muls., both of which are known to occur in Porto Rico.

BARTLETT (K. A.). **The Introduction and Colonization in Puerto Rico of** *Dasyscapus parvipennis* **Gahan, a Parasite of Thrips.**—*Agric. Notes Puerto Rico Exp. Sta.* no. 87, 6 pp. Mayaguez, P.R., 1938. [Recd. 1939.]

An account is given of the rearing in Porto Rico of *Dasyscapus parvipennis*, Gah., which was introduced from Trinidad for the control of *Selenothrips rubrocinctus*, Giard, on mango, cacao and other plants [*R.A.E.*, A **25** 424]. The rearing technique is a modification of that used in Trinidad. Between March 1936 and June 1938, 33 generations of *D. parvipennis* or 88,315 pupae were reared. Liberations were made in many sections of the island, the two methods used being described, but recoveries were only made within one generation of release in the neighbourhood of points of liberation, and it is thought that the parasite is not able to maintain itself sufficiently under existing conditions to be of value in the control of thrips in Porto Rico. Two shipments of *D. parvipennis* to the United States were made in 1936, one for liberation in greenhouses in Maryland and one for experimental work by F. F. Smith. Smith obtained oviposition in *Heliothrips haemorrhoidalis*, Bch., but concluded that the parasite would not be of value in controlling thrips on plants that are carried through the winter at temperatures as low as 50–55°F., or even, probably, at 65°F.

WILLE (J. E.), OCAMPO (J. A.), WÉBERBAUER (A.) & SCHOFIELD (D.). **El cube** (*Lonchocarpus utilis*) **y otros barbascos en el Perú.** [Cubé and other Barbasco Plants in Peru.]—*Bol. Estac. exp. agric. Minist. Fom. Peru* no. 16, 129 pp., 31 pls., 163 refs. Lima, 1939.

The text of this revised edition of a bulletin already noticed is practically the same as that of the original one [*R.A.E.*, A **25** 760], but it includes the botanical description by A. C. Smith of *Lonchocarpus utilis* [*cf.* **26** 319], which is the important commercial species known as cubé and was previously misidentified as *L. nicou*. There are also a few additional notes on the cultivation of cubé, and some statistical and other data of commercial interest.

BREDO (H. J.). **Catalogue des principaux insectes et nématodes parasites des caféiers au Congo Belge.**—*Bull. agric. Congo belge* **30** no. 2 pp. 266–307, 33 figs. Brussels, 1939.

This list of pests that attack coffee in the Belgian Congo, with notes on the bionomics and control of some of them, is a revision of one already noticed [*R.A.E.*, A **23** 378]. Additional insects recorded [*cf.* also **25** 192] include: *Gracilaria coffeifoliella*, Motsch., *Stictococcus formicarius*, Newst., *Ischnaspis longirostris*, Sign., *Icerya tremae*, Vayss., *Diaspis boisduvali*, Sign., *Coccus hesperidum*, L., *Aspidiotus gracilis*, Balachowsky, *Coccus* (*Lecanium*) *africanus*, Newst., *Toxoptera aurantii*, Boy., and thrips, which attack the leaves; *Stephanoderes subvestitus*, Egg., *Ceratitis capitata*, Wied., and *Thliptoceras octoguttale*, Feld., which infest the fruit; *Lygus coffeae*, China, and *Volumnus obscurus*, Popp., which attack the flowers; *Xyleutes armstrongi*, Hmps., and *Dirphya princeps*, Jord., which bore in the branches; various Longicorns that occasionally infest the stems; *Dasus simplex*, F., which destroys the roots; and *Miselia inferior*, Gn., a cutworm that feeds at the junction of stem and root. The leaf-rolling Pyralid, previously unidentified [**23** 378], is *Dichocrocis* (*Conogethes*) *crocodora*, Meyr. [**22** 709].

PETTEY (F. W.). **The Protection of Spineless Cactus Plantations against** *Cactoblastis*.—*Fmg in S. Afr.* 1939 repr. no. 2, 3 pp., 2 figs. Pretoria, 1939.

The information in this paper on the protection of spineless cactus (*Opuntia*) from *Cactoblastis* [*cactorum*, Berg], introduced into South Africa for the control of prickly-pear, has been noticed from an earlier one [*R.A.E.*, A **22** 616]. It is now recommended that plantations should be inspected for egg-sticks at least three times between the middle of September and the middle of November, and three times between the middle of February and the middle of April.

ADLE (A. H.). **Iran : First Outbreak of the Pink Cotton Bollworm,** *Pectinophora [Platyedra] gossypiella.—Int. Rev. Agric.* **13** no. 7 pp. 154 M–155 M. Rome, 1939.

Platyedra gossypiella, Saund., was first reported on cotton in Iran in 1937 and has since been found to occur in a number of districts in the south-east. Legislation providing for its control was enacted in June 1938. In the affected area, the growing of cotton is prohibited for a period of several years and standing crops must be burned. Crops in the surrounding areas where infestation is considered likely to occur must undergo periodical inspection and if found to be infested must be burned on the ground and destroyed ; all plants must be pulled up and burned after picking. Provision is made for the disposal of all cottonseed existing in the regulated area, and in general the transport of cotton from southern to northern districts is prohibited. Cotton from each region must be ginned separately and the waste burned.

HUTSON (J. C.). **Report on the Work of the Entomological Division.**—*Adm. Rep. Dir. Agric. Ceylon 1937* pp. D 37–D 42. Colombo, 1939.

The insect pests that occurred in Ceylon during 1937 include the following species that have not been recorded recently [*cf. R.A.E.*, A **24** 102, 765 ; **26** 358] : *Parasa lepida*, Cram., and *Psyche albipes*, Moore, on coconut ; *Dorylus orientalis*, Westw., which caused severe injury to seedling coconut and also attacked potato tubers and the roots of tree tomato (*Cyphomandra betacea*) ; *Scotinophara* (*Podops*) *lurida*, Burm., on rice ; *Cryptorrhynchus mangiferae*, F., on mango ; *Petalocnemis obscura*, Dall., on egg-plant (*Solanum melongena*) ; *Gracilaria soyella*, van Dev., on *Cajanus cajan* ; *Prodenia litura*, F., on castor (*Ricinus communis*) ; *Batocera rubus*, L., and *Macrochenus tigrinus*, Ol., on *Artocarpus integer* ; and *Dacus caudatus*, F., in fruits of *Garcinia xanthochymus*. The Cossid, *Azygophleps scalaris*, F., which has not previously been recorded in Ceylon, infested the stems of *Sesbania speciosa*.

Pests found on food-plants on which they had not previously been observed in Ceylon included the Notodontid, *Stauropus alternus*, Wlk., the Coreid, *Anoplocnemis phasiana*, F., and a Melolonthid of the genus *Serica* on *Citrus* ; *Empoasca* sp. on *Hibiscus esculentus* ; *Apomecyna saltator*, F. (*pertigera*, Thoms.) on snake gourd (*Trichosanthes anguina*) ; *Tiracola plagiata*, Wlk., on leaves of root artichoke (*Helianthus tuberosus*) ; *Epilachna vigintioctopunctata*, F., on potato ; *Zeuzera coffeae*, Nietn., on peach ; *Selepa* (*Plotheia*) *celtis*, Moore, on sapodilla (*Achras sapota*) ; *Aspidiotus destructor*, Sign., on leaves of mangosteen (*Garcinia mangostana*) and of cashew nut (*Anacardium occidentale*) ; *Prodenia litura*, F., and *Heliothis armigera*, Hb. (*obsoleta*, F.) on *Crotalaria juncea* ; *Brachyacma palpigera*, Wlsm., and *Araecerus fasciculatus*, DeG., in pods of *Tephrosia purpurea* and *T. villosa* ; *Colobodes billbergi*, Boh., boring in stems of *Cajanus cajan* ; *Hyblaea puera*, Cram., *Chelaria* sp. and *Spilonota* sp. on young leaves of *Dipterocarpus zeylanicus* ; *Achaea janata*, L., on young plants of *Pericopsis* *mooniana*; and *Gymnogryllus humeralis*, Wlk., in nursery beds of *Alstonia macrophylla*.

Infestation of coconut by *Nephantis serinopa*, Meyr., continued to decrease during the year and was lower in the Batticaloa district on the east coast than for many years past. The pupal parasite, *Trichospilus pupivora*, Ferrière, was liberated on infested estates, and evidence indicated that it was becoming established on some of these during the dry weather, in spite of competition from local larval parasites, especially the Tachinid, *Stomatomyia bezziana*, Baranov, which also contributed to the control of the Tineid. Of the 5 hosts that have been used for breeding *T. pupivora*, the most satisfactory are *Prodenia litura*, *Spodoptera mauritia*, Boisd., and *Tiracola plagiata*, laboratory strains of all of which can usually be maintained by the periodical introduction of fresh material from the field. *N. serinopa* and *Sylepta derogata*, F., are less satisfactory. In 1937, the main hosts used were *Prodenia* and *Tiracola*, and the output of parasites was doubled.

Breeding and liberation of the imported parasites, *Spalangia* sp. and *Dirhinus auratus*, Ashm. [**26** 359], was continued during the year, and both species are now established as parasites of *Dacus cucurbitae*, Coq., on cucurbits, but neither has become established in *Citrus* areas, where they were released for the control of *D. ferrugineus*, F.

In laboratory tests on the control of the Acridid, *Aularches miliaris*, L., contact sprays, especially one containing fish oil and soft soap, were more effective against the nymphs than arsenical or other stomach poisons. After reaching the second instar, the nymphs are more resistant, and sprays should therefore be applied during the first two or three weeks after hatching.

King (C. B. R.). **Report of the Entomologist for 1938.**—*Bull. Tea Res. Inst. Ceylon* no. 19 pp. 34–37. Talawakelle, 1939.

There was no severe outbreak of the tea tortrix [*Homona coffearia*, Nietn.] in Ceylon during 1938, though it occurred in a number of localities in the dry zone between April and July and persisted in one until October. Two liberations of its larval parasite, *Macrocentrus homonae*, Nixon [*R.A.E.*, A **27** 19] were made in this locality; at the end of the year the Braconid was established throughout an area of about 600 sq. miles [*cf.* **26** 639]. Infestation of tea by nettle grubs [Limacodids] has decreased in both intensity and extent during recent years. It was reported from only twelve estates during 1938, and spraying was necessary in only a few of these. A table is given showing for the years 1931–38 the average numbers of outbreaks, the average acreage affected and the percentage of acreage affected per month in five districts. Work on the bionomics of the shot-hole borer [*Xyleborus fornicatus*, Eichh.] was continued [**25** 670]. Short galleries were found in many alternative food-plants, but the Scolytid was unable to maintain itself and breed successfully on any that were investigated. The existence of morphologically similar races that do not interbreed and that may carry racially different fungi is tentatively suggested.

Ragmus importunitas, Dist., severely damaged *Crotalaria anagyroides* during June. Outbreaks of this Capsid occur sporadically in restricted localities, and since in the wet zone it generally appears in April and dies out later, planting should be delayed until August. Seedlings and unpruned plants are most severely damaged. *Toxoptera aurantii*, Boy., which attacks the new shoots of tea formed after pruning and sometimes also the shoots of mature bushes, was more abundant than usual on some estates. This Aphid is controlled by natural enemies. *Grevillea* was defoliated by *Paratetranychus* (*Tetranychus*) *bioculatus*, W.-M., and colonies of females of *Tenuipalpus obovatus*, Donn. [**25** 334]. In some cases, the two mites occurred together, and the latter also defoliated tea.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **50** pt. 6 pp. 317–320, 4 figs. Sydney, 1939.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **28** 46] includes notes on *Gryllulus* (*Gryllus*) *servillei*, Sauss. In the Sydney district in the first half of 1939, this cricket, which appears generally to feed mainly on weeds and grass, became unusually numerous and attacked garden plants, and in several instances, entered houses and damaged clothing, particularly that containing artificial silk. It lived for some weeks in the laboratory, feeding on grass seed. The nymphs and adults are briefly described.

In the north-east of New South Wales during March and April 1939 instances were recorded of the destruction of cucumber by larvae of *Margaronia* (*Phacellura*) *indica*, Saund. Brief descriptions are given of the larva and adult of this Pyralid. It may be controlled by dusting the plants with a mixture of 1 part lead arsenate and 4 parts kaolin, talc or hydrated lime.

In the warmer coastal region of New South Wales, *Coccotrypes dactyliperda*, F., damages buttons of vegetable ivory, especially those on garments stored on shelves. The eggs are laid in burrows made in the buttons by the adult, and the life cycle lasts about 30 days in summer and 70 days in winter. "Dum" buttons [from the seeds of the doum nut palm, *Hyphaene thebaica*] were more readily attacked than the harder "corosso" buttons [from *Phytelephas macrocarpa*], which seemed less suitable for development. Those made of casein were unsuitable for breeding, and were damaged only slightly by the boring of the adults. Badly infested buttons should be destroyed, those with slight infestations should be dipped in boiling water, and articles to be stored should be wrapped in paper. Alternatively, complete control of this pest can be obtained by keeping the buttons at 135°F. for one hour, or by fumigating with carbon bisulphide at the rate of 5 lb. per 1,000 cu. ft.

McCulloch (R. N.). **A simple Ant Bait.**—*Agric. Gaz. N.S.W.* **50** pt. 6 p. 348. Sydney, 1939.

Iridomyrmex rufoniger, Lowne, has been successfully controlled in houses in Sydney, New South Wales, for three years, with very small quantities of a bait consisting of 1 part sodium arsenite (80 per cent. arsenious oxide), 16 parts water, and 288 parts honey, by weight. After it had been stored for 18 months in half-filled bottles, the bait bore no mould, and was readily eaten by the ants. It did not attract *Monomorium pharaonis*, L.

Cawthron Institute, Nelson, New Zealand. Annual Report 1938.—35 pp., Nelson, N.Z. [1939.]

Sections of this report deal with insect pests and work on them in New Zealand during 1938. Investigations on the bionomics of the

Tineid, *Carposina adreptella*, Wlk., which is a major pest of raspberry in New Zealand, where it also feeds on blackberry and *Rubus australis*, showed that eggs are deposited between the leaves in unopened buds and that the larvae attack the lateral and terminal buds, frequently boring into the terminal shoots [*cf. R.A.E.*, A **27** 37]. Winter is passed in the larval stage and pupation frequently occurs in the soil. The foliage of raspberries in Canterbury was damaged to some extent by the European Tenthredinid, *Priophorus tener*, Zaddach, which in New Zealand has two generations a year, with sometimes a partial third in late autumn. The adults are active during September–December and oviposit in the stems of raspberry and blackberry. *Ephestia elutella*, Hb., and *Lasioderma serricorne*, F., damaged stored tobacco in one warehouse. Overwintered larvae of the former pupated about the end of September, and adults emerged at the beginning of November.

Work on the control of noxious weeds by insects was continued [*cf.* **27** 449]. Infestation of pods of gorse [*Ulex europaeus*] by larvae of the imported Curculionid, *Apion ulicis*, Forst., reached nearly 99 per cent. in a district in the South Island where it was first released some years ago [**20** 271] and which has been burned over in recent years, and was as high as 90 per cent. in another locality where the weevil has increased to such an extent during the last seven years that it is now prevalent at a distance of half a mile from the original point of liberation, and is rapidly reinfesting burned areas.

Timber in buildings in New Zealand is attacked by *Lyctus* spp., *Anobium punctatum*, DeG. (*domesticum*, Geoffr..) and the native Cerambycid, *Ambeodontus tristis*, F. ; buildings in two districts on the west coast of the North Island were severely damaged by the Australian mound-building termite, *Coptotermes lacteus*, Frogg.

MASSEE (A. M.). **Notes on some interesting Insects observed in 1938.**—*Rep. E. Malling Res. Sta.* 1938 pp. 180–185, 1 pl., 1 ref. East Malling, 1939.

Insects of economic importance observed in south-eastern England in 1938 included *Batophila aerata*, Marsh., adults of which occurred in Kent on the leaves of a cultivated variety of blackberry during April and May, and on the leaves of raspberry during October. The normal food-plant of this Halticid is wild blackberry. *Dasyneura tetensi*, Rübs., continues to increase each year in Kent and parts of Hampshire [*cf. R.A.E.*, A **26** 612], and may become a serious pest of black currant. In 1938, it was reported from Hampshire on 10th May, much earlier in the year than usual. Neither dipping the affected growth in a nicotine wash nor spreading commercial naphthalene under the bushes, at the rate of 4 cwt. per acre, gave effective control. *Anthonomus piri*, Koll. (*cinctus*, Redt.) has been found in many parts of Kent since it was first recorded in England in 1921 [**12** 562]. It occurs in small numbers on apple, but never becomes very abundant, even in neglected orchards. In the summers of 1936 and 1938, adults of *Otiorrhynchus ovatus*, L., were observed damaging the buds of apple and plum stocks in propagation beds. The weevils feed mainly at night, on the bark and on the petioles, girdling the stems and severing the leaves. During the day they hide under stones or earth. Apple root-stocks were also damaged by *Lyonetia clerkella*, L., which had been uncommon in Kent since 1922 and 1923. In October 1938, larvae of the second generation were observed mining the foliage of the stocks, and adults were reared in November. The larvae make characteristic irregular tunnels in the leaf tissues of apple and hawthorn. Usually only one larva occurs in a leaf, and when full fed it leaves the mine and spins a cocoon, usually on the lower surface. The pupal stage lasts 10–21 days. There are two generations a year, and the adults of the second overwinter in sheltered places. *Argyresthia nitidella*, F., has recently become more common in cherry orchards in Kent. The larvae of this Tineid feed on the young fruits [*cf.* **16** 615].

In October 1938, peach trees that were dying back were found to be attacked by larvae of *Aegeria* (*Conopia*) *myopaeformis*, Bkh., which usually infests apple. The unusual amount of gum exuding from the stems was a result of the boring of the larvae. They feed in tunnels just below the bark, and come to the surface before pupating. Thorough scraping of the bark to remove the gum and painting the stems with 10 per cent. tar-distillate wash killed many of the larvae, and it was decided to repeat this treatment in the spring before the overwintered larvae pupated.

Leaf-curling Aphids on apple and pear were much more prevalent in 1937 and 1938 than in several previous seasons, and were common in orchards that had received tar-distillate washes. It is not known whether the species on pear is the rosy apple aphis, *Anuraphis roseus*, Baker, or a closely related species. A severe infestation occurred in one orchard on pears that had not been sprayed with tar distillate during the previous winter. By 28th June, most of the winged forms had left the trees, and colonies were observed on greater plantain [*Plantago major*] growing under the trees. Alate and apterous forms were present. *Tetranychus telarius*, L., was reported on hops in several parts of Kent in June and July instead of in August as in other seasons. Characteristic mottling and blisters on the upper surfaces of fig leaves were found to be caused by the mite, *Eriophyes ficus*, Cotte, which had not hitherto been recorded in Great Britain.

Larvae causing serious damage to cabbage by feeding on the fibrous roots were identified as *Aphodius fimetarius*, L. Larvae placed on the soil in pots containing small cabbage plants burrowed into the soil within a few minutes and did not return to the surface. After three weeks, the plants began to turn yellow, and later the lower leaves dropped off and the plants wilted. It was found that most of the fibrous roots and part of the main roots had been eaten. All the larvae were living and buried themselves again when transferred to new pots. This appears to be the first authentic record of dung-beetle larvae as pests in England.

GREENSLADE (R. M.) & MASSEE (A. M.). **The Control of Strawberry Aphis and Tarsonemid Mite.**—*Rep. E. Malling Res. Sta.* 1938 pp. 186–190, 1 ref. East Malling, 1939. **Suggestions for Control of Strawberry Aphis.**—*T.c.* pp. 250–252, 1 ref.

In the first of these papers, accounts are given of work in south-eastern England on the control of *Capitophorus fragariae*, Theo., and *Tarsonemus pallidus*, Banks, on strawberries. The information on the control of the Aphid has already been noticed [*R.A.E.*, A **27** 395]. A dust and a considerable number of sprays were ineffective against *T. pallidus*, chiefly owing to the difficulty of reaching the mites in the young unopened leaves, although various wetting agents were used, and warm-water treatment of the runners [**22** 234, etc.] was adopted. The measures recommended in the second paper against *C. fragariae* comprise dipping the runners into warm water or, in districts in which this is attended by high mortality of the plants, dipping them for 2 or 3 minutes in a solution of 2 oz. nicotine (95–98 per cent.) and 2 lb. soft soap in 25 gals. water, taking care to wet the crowns ; spraying runner beds, and, if necessary, established plants with nicotine before and after the spring migration [**27** 395] ; and burning the straw litter after the fruit is picked.

DICKER (G. H. L.). **The Bramble Shoot-webber** (*Notocelia uddmanniana* **L.**).—*Rep. E. Malling Res. Sta.* 1938 pp. 191–198, 1 pl., 4 refs. East Malling, 1939.

All stages are described of the Tortricid, *Eucosma* (*Notocelia*) *uddmanniana*, L., and an account is given of its distribution and of investigations on its bionomics in south-eastern England in 1937–38. It occurs only on plants of the genus *Rubus*, and is fairly common on cultivated varieties in the main fruit-growing areas in England, though it has caused no serious damage except in the district of Cambridge.

There is one generation a year. The eggs are laid singly on the upper or lower surfaces of young leaves near the tip of a new cane, usually only one per leaf, and hatch in 13–18 days. The larva migrates at once to the growing point and lives between the upper halves of a slightly opened leaf, which it webs together. Later, it moves up the cane to a more tender leaf, and finally burrows into the growing point of the cane. Little damage is done, however, as the larvae are still very small. They cease feeding in August, during the third or occasionally during the second of the five instars, and move down the canes and hibernate between the bases of leaf stalks and the buds or canes, or under pieces of dead bark. Larvae in the second instar moult soon after constructing the winter cocoon. Hibernation lasts 7–8 months, the larvae emerging between 4th April and 2nd May in 1937, and between 28th March and 25th April in 1938. In these years, 90 per cent. of the larvae had resumed feeding 16 and 18 days, respectively, after the first one had appeared. Some of the larvae remain on what are now the fruiting canes and feed on the fruit laterals, after webbing the leaves together, and later tunnel into the blossom buds and eat the interior. When the blossom buds reach an advanced stage, the larvae usually move to the young canes ; they web together the leaves round the growing points until the terminal buds are covered, and feed on the young leaves and the bud. Others migrate to the new canes immediately after hibernation, and web the leaves round the tips of the shoots in the same way. The larva usually remains in the same web on the new cane until it pupates. Usually only one larva is found in each web, unless the infestation is heavy, when there may be three or four. All pupation takes place between the last week in May and the end of June, and the pupal stage lasts 17–28 days. The first adults appear during the last week in June. They live 9–15 days, the female laying over 200 eggs, and are present until the end of July or early August. They rest on the lower surface of the leaves during the day.

All species of the genus *Rubus* and their hybrids are attacked, but loganberries and phenomenal berries are the only widely-grown varieties that are severely damaged. Wild blackberry is a favourite food-plant, and is a potential source of infestation, since the Tortricid can generally be found on almost any big clump of brambles in south-eastern England.

Parasites reared from *E. uddmanniana* comprised the Ichneumonid, *Omorgus mutabilis*, Hlmgr., which was the only one to give any effective control, an undescribed Braconid of the genus *Apanteles*, and the Tachinid, *Nemorilla notabilis*, Mg., one example of which was bred from a pupa of the host. During the years 1936–38, the percentage parasitism by *O. mutabilis* varied from 36 to 48. The egg is deposited in the larva of the host, probably during the first instar. The latter continues feeding, and both host and parasite overwinter and become full-fed in June. The parasite then breaks out of the host and pupates. *O. mutabilis* is widespread in England and has been reared from larvae sent from several counties in the south and midlands.

Attempted control measures included the application to the canes during the winter of a 10 per cent. tar-distillate wash, which gave no control, and spraying after the larvae resumed feeding in April, which was difficult because of the length of time over which they emerge and their habit of spinning protective webs. No control was given in 1937 by a single application at this time of a suspension of lead arsenate, since plant growth was too rapid for adequate coverage to be maintained, or by two of a spray of derris extract and soap. An atomised spray of pyrethrum extract in a white oil of the kerosene type (viscosity 30 Say., 99 per cent. unsulphonatable residue) and containing 0·5 per cent. pyrethrins, applied on 4th April 1938, killed 41 of 42 larvae on 20 plants, but in a field trial on 6th May, when all the larvae were surrounded by large webs and the spray was applied at half the strength, only 6·5 per cent. control was obtained.

SHAW (H.) & STEER (W.). **Spray Residue Investigations. III. The Influence of Petroleum Oil and of Lime-sulphur on the Retention of Lead Arsenate on Apples.**—*Rep. E. Malling Res. Sta.* 1938 pp. 199–203, 1 fig., 1 ref. East Malling, 1939.

Investigations, begun in 1937, on the effect on the deposition and retention of arsenical residues on apples of the addition of oil and lime-sulphur to lead-arsenate sprays [*R.A.E.*, A **26** 614] were continued in 1938. The materials used were the same, except that the lethalate wetting agent was omitted, and applications were made on 2nd July. The deposit from lead arsenate alone was fairly evenly distributed. That from lead arsenate and oil was less even, but adhered in larger drops. The addition of lime-sulphur to either spray seemed to improve the evenness of distribution. Sprays containing lime-sulphur caused yellowing and falling of leaves, which was more severe when oil was also included in the spray. The other sprays caused no obvious damage. Lime-sulphur, with or without oil, checked the growth of the fruit, and it is therefore considered that residue weights should be compared on the basis of a given number of fruits rather than on a given weight of fruit. The analysis of arsenic residues per 100 fruits in samples picked on 6th and 25th July, 15th August and 29th September gave inconsistent results, but though none of the differences in deposit was statistically significant, the addition of oil only to the lead arsenate apparently increased the deposit of arsenic. There was no evidence that the persistence of the deposit was affected either by the constituents of the wash or by weathering. The apparent loss of residue on a given weight of fruit was due to fruit growth.

JARY (S. G.). **The Control of Hop Red Spider : Some recent Experiences.**—*J. S.-E. agric. Coll.* no. 44 pp. 37–38. Wye, Kent, 1939.

Following experiments on the control of the red spider [*Tetranychus telarius*, L.] on hops by treatment of the poles in winter and the application of lime-sulphur wash to the hop foliage in summer [*R.A.E.*, A **24** 60], the effect of these measures in commercial practice was observed in Kent. The application of tar-oil wash at 5 per cent. concentration to large cracks in poles gave a high degree of freedom from attack in the only case in which it was possible to observe its effect under commercial conditions. In a part of the same field in which the poles were not treated, infestation was appreciable. For practical purposes, lime-sulphur wash at 1 : 100 was sufficiently strong. Two applications are desirable for severe attacks, but one is sufficient for normal infestations. Risk of damage to hops decreases as the season advances until the plant is in burr, when it is negligible, but after the cones have begun to form, lime-sulphur should on no account be applied. It is usually unnecessary to apply lime-sulphur before the burrs form, as infestation increases rapidly only when the weather is dry. Lime-sulphur and Bordeaux mixture did not injure the plants when applied within a few days of each other, although a dark brown deposit formed on the leaves. There appeared to be no advantage in adding a spreader to lime-sulphur.

JARY (S. G.). **A Note on Tyroglyphid Mites occurring in Silage and on Lily of the Valley.**—*J. S.-E. agric. Coll.* no. 44 pp. 59–67, 6 figs., 3 refs. Wye, Kent, 1939.

A Tyroglyphid mite heavily infesting silage of oat and vetch [*Vicia sativa*] at Reading in June–July 1938 was found to belong to the sub-genus *Cosmoglyphus* of the genus *Eberhardia*. Assuming that two hypopi that occurred in the sample, but were not reared to the adult stage, belonged to the Tyroglyphid, it was similar to if not identical with *E.* (*C.*) *krameri*, Berl. The mites, which were practically confined to the leaves of the vetch, occurred in greatest abundance in the upper 6 ft. of silage, in very small numbers in the next 3 ft., and not at all below that depth. The silage was somewhat browned and possessed a distinct flavour of burnt sugar. Its moisture content was 67 per cent. Characters of the adult male that differentiate the Tyroglyphid from the species of *Eberhardia* recorded from mushrooms [*R.A.E.*, A **27** 1] are given.

In February 1939, roots of plants of lily of the valley (*Convallaria majalis*) from Sussex, which had been imported and were making little or no growth, were found to be rotting and heavily infested by Tyroglyphid mites. It was not possible to determine whether the mites were primarily injurious or feeding only upon the decaying tissue. They were bred for many weeks on the roots, and colonies readily established themselves on slices of mushroom tissue, on which eggs were laid freely and adults were reared. They belonged to a species of *Caloglyphus* closely related to a species previously taken from mushrooms and provisionally referred to as *C. berlesei*, Mich. [*loc. cit.*]. Females, normal males and heteromorphic males were produced, the heteromorphic male form in unusually large numbers. In the species taken on mushroom, this type of male was rare. The species does not appear to agree with any of those of the genus *Caloglyphus* listed by Zakhvatkin [**26** 94]. Characters are given distinguishing the forms from lily of the valley and mushroom. From the hypopus, it appears that the mite from lily of the valley is most nearly related to *Caloglyphus moniezi*, Zkhv., of which, however, the heteromorphic male is, according to Zakhvatkin, unknown. So far as is known, it has not previously been recorded in England.

Jary (S. G.). **Investigations on the Insect and allied Pests of cultivated Mushrooms.—XIII. Another Tyroglyphid Mite.**—*J. S.-E. agric. Coll.* no. 44 pp. 68–72, 4 figs., 3 refs. Wye, Kent, 1939.

Among examples of Tyroglyphid mites from cultivated mushrooms in Kent received in March 1939 were small numbers of adults and several hypopi of the genus *Caloglyphus*. The hypopi and adults reared from them were identical with those of a species of *Caloglyphus* recorded from mushroom in 1938 [*R.A.E.*, A **27** 1] and provisionally referred to as *C. berlesei*, Mich., while the eggs that were eventually obtained agreed exactly in size, but the adults present in the mushrooms were considerably smaller than those found in 1938, though they otherwise bore a marked resemblance to them. A colony of the smaller mite was established on mushroom tissue ; one heteromorphic male occurred among the individuals obtained, and hypopi were also produced. The difference in the size of the eggs of the two forms was proportionate to that of the adults. It is thought that the adults found in 1939 probably belong to a smaller race of the species found in 1938. Reference to many slides in the author's collection, made from 1932 onwards, shows that this species of *Caloglyphus* was frequently taken on cultivated mushrooms during the earlier part of the investigation, when attempts were being made to obtain and identify the mite described by Michael as *Tyroglyphus mycophagus*, Mégn. The name *T. mycophagus* has often been given to species other than that described by Michael, including *C. berlesei* [**26** 94].

Jary (S. G.) & Austin (M. D.). **Investigations on Insect Pests of Brassica Seed Crops in Romney Marsh.**—*J. S.-E. agric. Coll.* no. 44 pp. 73–83, 2 figs., 18 refs. Wye, Kent, 1939. **II.**—*T.c.* p. 84.

The yields of seed crops of crucifers (swedes and a hybrid kale) in the Romney Marsh area of Kent have been unsatisfactory for many years, and recently the best have fallen to little more than half the normal. The first paper is intended as a progress report on an investigation into the damage caused to the crops by insect pests, and consists of a brief review of the literature on such damage in England and various European countries and accounts of the practice followed in growing crops for seed in Romney Marsh, the nature of attack by *Meligethes aeneus*, F., which appeared to be of primary importance [*cf. R.A.E.*, A **15** 579], its life-cycle, and field and laboratory trials of insecticides for its control.

The life-cycle of this Nitidulid as observed in Romney Marsh does not differ materially from that recorded in Germany [**8** 542] and Russia [**18** 49]. The period from egg to adult occupies about 6 weeks. Adults emerge from hibernation, the preferred sites of which are not known, and appear suddenly on the crop at varying times, but usually about mid-April when minute flower buds are apparent, and at least a fortnight before flowers normally open. When the temperature is low and the weather dull and windy, the beetles shelter among the buds, but on sunny days they fly freely. They feed on the minute flower buds and destroy them. This is the most severe type of injury and in the case of the kale has sometimes amounted to complete destruction of the crop. Later, feeding takes place in open flowers, but this is less serious, as an appreciable amount of seed matures. In spite of the crop rotation practised to prevent cross-fertilisation, very large populations persist. The wild food-plants in Romney Marsh are comparatively few. Oviposition begins soon after the appearance of the adults, and sometimes lasts until 9th June. By this time, adults of the new generation have begun to emerge. It is thought, however, that there is only one generation a year and that these adults do not pair until the following season. Eggs are generally laid in tightly closed uninjured buds showing no petal colour, two in each bud, inserted through a hole made at the base by feeding. The larvae feed first within the buds in which they hatch and then migrate to others. When full-fed, they descend to the soil and make cells in which to pupate.

Control measures that have been used in the past are reviewed. In preliminary experiments, " topping," a process consisting in severing the main shoot at about 12 ins. above ground level, had no apparent effect on infestation in a field of kale, and two thorough applications in May of pyrethrum, derris, and lead arsenate dusts also failed to protect the crop, which was a total loss. Four applications of the same derris dust to swedes, on 24th and 26th May, under bad weather conditions, and on 9th and 14th June, increased the crop only very slightly over the control and failed to affect larval development to any great extent. In the field, kale was invariably more heavily attacked than swedes [*cf.* **26** 296] and appeared to support larger populations, but the greater injury may be related to the time taken by the buds to grow beyond the stage when they can be destroyed. During May and June 1938, tests under insectary conditions were carried out with a derris dust consisting of 10 per cent. ground derris (5½ per cent. rotenone) and 90 per cent. ground North African phosphate, a pyrethrum dust consisting of a mixture of equal parts of North African phosphate and colloidal clay to which was added 1 per cent. pyrethrum extract (1 lb. pyrethrum extract was equivalent to 10 lb. pyrethrum flowers), and a lead-arsenate dust containing 20 per cent. by weight of a lead-arsenate powder (32 per cent. As_2O_5), all as employed in the field trials, and colloidal silica and ground North African phosphate used alone. The experimental technique is described. There were four series of experiments, begun on 20th and 27th May and 7th and 10th June, and the cages were examined daily for six days following treatment. Mortality in untreated controls increased between 20th May and 16th June, agreeing with observations in the field; it averaged 0, 17·5 and 42·5 per cent. in six days in the first, second and fourth series of experiments. The figures obtained in the experiment begun on 7th June were aberrant and the series was abandoned after three days. Lead arsenate gave only about 50 per cent. mortality in six days in the first two series and was inferior to derris, but in series 4, it gave 75 per cent. mortality by the third day and 100 per cent. by the sixth day. Unlike derris, it thus became more effective as the beetles became older, and did not exert the same marked repellent effect as other substances, the beetles invading the dusted plants more or less normally, but preferring to feed on any tissue not actually coated with the dust. Mortality caused by derris in series 1, 2 and 4 after three days was 62·5, 35 and 25 per cent., and after six days, 85, 62·5 and 82·5. The general effect was that of a repellent. After a period of abnormal activity following the first contact with dusted plants, there was no visible effect except that feeding appeared to be largely prevented, so that mortality may have been partly due to starvation. This might explain the apparent decrease in toxicity as the season advanced, as the beetles used in the earlier series would have had a shorter period for feeding in the field than those used in the later ones. The toxicity shown by pyrethrum in series 1 and 2 was consistently low, and beetles, on the whole, survived longer in contact with this dust than with others, but, like lead arsenate, it appeared to be more effective against older beetles, and gave complete mortality after six days in one of two tests in series 4. The beetles showed great activity on first contact, and there was a more or less pronounced repellent action. Colloidal silica, which was not tested in the first series, gave 75 and 20 per cent. mortality on the third day and 95 and 92·5 on the sixth day in the second and fourth. North African phosphate was also included in the last three series because it was an ingredient of the derris and pyrethrum dusts. It produced an appreciable mortality from the fourth day onwards in series 2, but its effect diminished in the later series.

The second paper comprises an account of preliminary trials with an atomised proprietary pyrethrum fluid, which was blown with a hand atomiser into lamp chimneys containing 10 beetles and closed with muslin at both ends, one of which was opened momentarily to admit the spray. All the treated beetles were dead after 12 hours, while all those in the controls lived at least 24 hours. In a small trial on a field crop, plants were given as small a dosage as possible on 27th May 1939, care being taken to prevent a visible liquid film from forming on the leaves, and the plants were unaffected except where leaves were appreciably wetted, when scorching became apparent within a few days. Beetles immediately showed characteristic activity, many rapidly lost the power of flight, dead beetles were found on the plants within an hour, and no appreciable reinfestation occurred for six days, though beetles were abundant in the remainder of the field. There is evidence that beetles that are not touched by an appreciable quantity of the liquid remain unaffected. *Ceuthorrhynchus pleurostigma*, Marsh., which was present in small numbers seemed to be affected in the same way as *M. aeneus*. It appeared that 2–4 gals. per acre would be an effective dosage.

JARY (S. G.) & AUSTIN (M. D.). **Investigations on Wireworms.—I.—** *J. S.-E. agric. Coll.* no. 44 pp. 85–91, 4 figs., 1 ref. Wye, Kent, 1939.

An account is given of preliminary data obtained in an investigation which is being made in Kent on the wireworm populations of permanent grassland and leys forming part of an alternate husbandry system, with a view to obtaining information on such points as the intensity and distribution of wireworm population to be expected in grassland of a given type, the possibility of devising a satisfactory method of assessing populations and of deducing whether any factors concerned with the management of grassland and its treatment both before and immediately after breaking are of value as control measures, and particularly the correlation, if any, between the wireworm population of grassland and subsequent injury to arable crops.

The samples taken were 6-in. cubes of soil as adopted by W. R. S. Ladell [*R.A.E.*, A **26** 620], and they were examined immediately in the field. The results are given of sampling in three fields, one that had been in arable cultivation since 1918 and in which a ley mixture of wild white clover, perennial rye grass [*Lolium perenne*] and rough-stalked meadow grass had been sown in barley in 1938 and which was surrounded on three sides by permanent grassland, one that had been permanent pasture for at least 50 years and was ploughed in the winter of 1938–39, and one that was permanent pasture until December 1937, when it was ploughed, and in which peas were sown in the spring of 1938 and wheat was drilled in the autumn of the same year. In the first, wireworms were found in only three of the fifty samples taken between 9th and 12th January 1939, 4 wireworms in all, and two of the three samples occurred in corners of the field, adjacent to grassland. No injury was apparent on barley crops in this field. In the second, counts, which were made between 30th December 1938 and 6th January 1939, were relatively low except for an area of consistently high population on one side. Injury to oats sown in February and examined in May showed a remarkable correlation with population, the area on the heavily infested side being markedly attacked, and two other isolated positions in which counts had been high being very noticeable. The crop in the rest of the field was not materially damaged. In the third field, from which a proportion of the wireworm population of permanent pasture would normally have disappeared, there was still an appreciable number on 18th April 1939, especially in two corners. However, while wheat was definitely injured in one of these corners, no injury of any consequence occurred in the other. Over the greater part of the field, damage was not of practical importance.

ROLFE (S. W.). **Notes on Diplopoda VI. The Recognition of some Millipedes of economic Importance.—III.**—*J. S.-E. agric. Coll.* no. 44 pp. 180–182, 7 figs., 2 refs. Wye, Kent, 1939.

Figures, supplemented by descriptive notes, are given of the vulvae of the three Polydesmids, one Strongylosomid and three Blaniulids mentioned in a previous paper in this series [*R.A.E.*, A **25** 706].

CANDURA (G. S.). **Osservazioni biologiche sul tonchio dei fagioli** (*Acanthoscelides obtectus* **Say) nella Venezia Tridentina.** [Biological Observations on the Bean Bruchid, *Bruchus obtectus*, Say, in the Trentino, Venetia.]—*Italia agric.* **75** no. 12 pp. 841–854, 10 figs. Rome, 1938. [Recd. 1939.]

Bruchus (*Acanthoscelides*) *obtectus*, Say, has become widely distributed in Italy as the result of the distribution to growers in 1917 of a shipment of infested beans from Brazil. All stages of this Bruchid are briefly described, and a list is given of the seeds from which it has been recorded. In investigations on its bionomics carried out at Bolzano, the longevity of males and females kept without food was least (4 and 2 days) in August, and greatest (64 and 60 days) in October–December. The averages were 16 and 23. Oviposition began a few days or up to a fortnight after pairing, which sometimes occurred on the day of emergence. In fields, the eggs were laid inside ripe bean pods, and in warehouses they were laid on the bottom and sides of the bins. Females normally deposit 40–80 eggs, which hatch in 5–45 days according to temperature and humidity. Eggs did not develop at relative humidities below 7 per cent. or temperatures below 17°C. [62·6°F.]. Newly hatched larvae survived without food for about 4 days and could travel considerable distances in search of a suitable seed. Boring into a bean took from 20 to 60 hours, and those in contact with the surfaces of the bin were more attacked than others because the larva requires a firm support when boring. Damaged or cracked seeds were readily attacked. Dry, ripe beans were preferred, whereas Bruchids that have only one generation a year attack unripe seeds in fields. Of 40 commercial varieties of *Phaseolus vulgaris*, 11 were preferred, and two of these are very commonly grown in northern Italy. The duration of the larval stage depends on temperature and nutrition, but it usually lasted 20–25 days in summer. The pupal stage, which is passed in a cell in the seed, lasted 5–25 days. In Italy there are 4–6 generations a year, and the author observed 5 at Bolzano, the life-cycle being completed in from 33 to 134 days. A series of 50 pairs produced 945 females and 681 males between 23rd September and 31st October 1938. Hibernation occurred in the larval stage, but pupae and adults were also observed in winter; these adults often died without ovipositing.

No insect parasites of the Bruchid were found, and the mite, *Pediculoides ventricosus*, Newp., which attacks the immature stages, is of no practical importance. Various measures that can be employed for the control of the Bruchid in stored beans are reviewed, and the use of carbon bisulphide, which is considered the most satisfactory fumigant, is discussed at some length.

CANDURA (G. S.). **Entomologia merceologica.** [Commercial Entomology.]—*Riv. Fis. Mat. Sci. nat.* **13** (2) no. 5 pp. 225–243, 12 figs. Naples, 1939.

This is a well illustrated account of the effects of insect infestation on stored products, particularly cereals, and of some of the factors that may affect the increase of infestation.

HACKBART (W.). **Der Einfluss kurzfristig wirkender Temperaturen auf die Entwicklung und Fortpflanzung von Schadinsekten.** [The Influence on the Development and Reproduction of harmful Insects of Temperatures effective for short Periods.]—*Z. Morph. Oekol. Tiere* **35** no. 3 pp. 469–534, 11 figs., 2 pp. refs. Berlin, 1939.

A detailed account is given of a series of laboratory investigations in Berlin on the influence on the development and fecundity of the Brazilian bean beetle, *Spermophagus* (*Zabrotes*) *subfasciatus*, Boh., of continuous exposure to constant unfavourable temperatures and of exposure to such temperatures for short periods. The optimum conditions for this Bruchid are 27°C. [80·6°F.] and 75 per cent. relative humidity, and its thermal limits of development are 19 and 35°C. [66·2 and 95°F.]. It is occasionally imported into Germany in beans from South America and is able to continue its development in warm storerooms and warehouses.

Continuous exposure to temperatures of 22 and 31°C. [71·6 and 87·8°F.] exercised an only very slightly injurious effect on development, but more unfavourable temperatures caused the ultimate extinction of colonies of the Bruchid. The injurious effect was proportionate to the degree of deviation from the optimum. In the investigations on the effects of short exposures to unfavourable temperatures, the Bruchids were bred under optimum conditions, exposed for varying periods to 40, 10 and 0°C. [104, 50 and 32°F.] and then restored to the optimum. The ways are discussed in which mortality, rapidity of development and reproductive capacity can be used as measures of the effects of such exposures, and the results are given and discussed with respect to total populations and selected populations containing the physiologically most resistant individuals. Exposure of the eggs for 4, 18 and 72 hours to 40°C. raised the percentage larval mortality to 40, 80 and 100, respectively. The periods required to obtain corresponding mortalities at 10°C. were considerably longer. Very short exposures of the larvae had little effect on mortality, but when they were exposed to 40 and 10°C. for 6 days, the percentage mortalities were 75 and 80–90. Complete mortality occurred after exposure at these temperatures for 11 and 8 days. Males were in general more resistant to unfavourable temperatures than females. Pupae were fairly resistant, and all examples tested gave rise to adults after exposure for 3 days at 40°C. The shortest duration of larval development (10·6 days at 27°C.) was prolonged 1 day by exposure for 1 day to 40°C., but was very little affected at 10°C. The fecundity of individuals exposed for various periods during the egg or larval stages to unfavourable temperatures was not affected, but those exposed during the pupal stage deposited fewer eggs. Young adults laid fewer eggs after exposure, and the low temperatures were more unfavourable than the high one. In no case was the fecundity of the following generation affected.

FRANSEN (J. J.). **De Colorado-kever.** [The Colorado Potato Beetle.]—*Tijdschr. ned. Heidemaatsch.* **50** pt. 9 pp. 288–314. Arnhem, 1938. [Recd. 1939.]

In view of the discovery of *Leptinotarsa decemlineata*, Say, in Holland in 1937 [*R.A.E.*, A **25** 763], the author reviews the work done, chiefly in the United States and France, on its biology and control.

Circulaire en mededeelingen 1938 van het comité ter bestudeering en bestrijding van insectenplagen in bosschen. [Circular and Communications issued in 1938 by the Committee for the Study and Control of Forest Pests.]—*Tijdschr. ned. Heidemaatsch.* **51** pt. 2 repr. 8 pp., 4 figs. Arnhem, 1939.

Most of the work done in Holland in 1938 by the committee for the study and control of forest pests was concerned with the pine sawfly, *Diprion pini*, L., which during recent years has done much injury to pines [*cf. R.A.E.*, A **26** 621]. J. J. Fransen states that the dust mixture that was used against the larvae contains an inert carrier or diluent, finely ground derris powder with a rotenone content suited to the stage of development of the larvae to be dusted, and a preparation of pyrethrum that serves as an irritant and is added because gregarious larvae are more sensitive when exposed individually than when grouped together, and come into contact with the poison more readily if disturbed.

FRANSEN (J. J.). **Het gebruik van vangstammen bij de iepenspintkeverbestrijding.** [The Use of Trap-logs against Elm Bark-beetles.]—*Tijdschr. ned. Heidemaatsch.* **51** pts. 5–6 pp. 141–156, 177–196, 10 figs., many refs. Arnhem, 1939.

An account is given of work in Holland on the use of trap-logs for the control of the elm bark-beetles, *Scolytus scolytus*, F., and *S. multistriatus*, Marsh., which transmit the fungus, *Ophiostoma* (*Ceratostomella*) *ulmi*, that causes disease of elms. Some workers have considered that the Scolytids breed in both dead and living trees, but in the author's experiments, in which beetles of both species that had completed maturation feeding were confined on elms dying through the attack of *O. ulmi*, they failed to establish themselves in the cambium, and individuals that had begun boring in the bark towards the cambium were killed by the sap exuded. It is concluded, therefore, that the Scolytids are secondary pests that breed only in trees that are dead and have no sap flow.

In experiments with trap-logs, thick logs were preferred to thin ones, because in them the beetles were able to bore in the thick bark without touching the sap-exuding cambium. Thick logs also dried more slowly and remained attractive for longer periods. Both beetles were able to make brood galleries in thin stems and branches 0·8 in. in diameter, and *S. multistriatus* did so readily. Logs from 8 to 16 ins. in diameter are the most satisfactory, since both species attack them readily. Healthy trees felled in winter were not suitable for use as trap-logs in the following spring [*cf. R.A.E.*, A **27** 397], but were rendered attractive by watering them with a solution of common salt, or gas-water, or sodium fluosilicate, or by covering the sawn ends with asphalt. The effect is possibly due to the drying out of the bark being delayed.

The number of brood galleries for a given area of bark varied greatly. In a normal infestation, about 50 may be expected per sq. yard. No galleries are made on the sunny side of the log or where it rests on the ground, and the logs should therefore be laid on supports in shady places and turned over from time to time. Logs should be in use from early May to the end of September. The life-cycles of *S. scolytus* and *S. multistriatus* last about 1 and 6 months, respectively, so that logs attacked by both species should be treated to prevent the emergence of adults about 4 weeks after the formation of the first galleries. The best method is still to bark the logs and burn the bark.

The author describes traps for catching the females before they have made brood galleries, but this method is too costly for general use. In further experiments, smearing logs with an adhesive trapped many females before they formed galleries, and such logs remained attractive longer than untreated ones, because the bark of the latter was soon eaten by the developing larvae. With a view to economising the adhesive, logs were later enclosed in butter muslin on which the adhesive was applied in strips. This proved effective, as females attempting to reach the bark moved about on the muslin and were caught by the adhesive. The latter remained sticky for about a month, and longer if the logs were protected by a roof.

Ahlberg (O.). *Diarthronomyia chrysanthemi* **nom. nov.** (=*hypogaea* **Felt nec Löw**). [*In German.*]—*Ent. Tidskr.* **60** pt. 3–4 pp. 274–278. Stockholm, 1939.

The author reviews the distribution in the United States, Canada and Europe of the Cecidomyiid that causes galls on the leaves, stems and buds of commercial chrysanthemums [*cf. R.A.E.*, A **27** 673] and was misidentified as *Diarthronomyia* (*Rhopalomyia*) *hypogaea*, F. Lw. [**3** 454], which was originally described from the underground parts of *Chrysanthemum atratum* in the Austrian Alps and is here referred to the genus *Misospatha*. He describes the male, the pupa and the gall of *M. hypogaea* and gives characters distinguishing it from the chrysanthemum midge, which he names *D. chrysanthemi*, sp. n. *M. hypogaea* occurs in the Austrian Alps at altitudes of about 5,000 ft. and must therefore be able to withstand severe and prolonged cold, whereas in experiments, all stages of *D. chrysanthemi* were killed by even moderately low temperatures.

From an examination of records, it is concluded that *M. hypogaea* occurs in Austria and probably also in southern France, while the Cecidomyiids recorded from *Chrysanthemum leucanthemum* in England [**16** 10] and Italy represent a still further form.

[Popov (V. I.).] **Попов (В. И.). Warehouse Insect Pests in Bulgaria and their Control.** [*In Bulgarian.*]—Med. 8vo, 195 pp., 107 figs., 11 pp. refs. Sofia, Plant Prot. Inst., 1939. Price 100 *leva*. (With a Summary in English.)

In Bulgaria, infestation of many kinds of stored products by insect pests is severe, owing to the poor condition of the storehouses and granaries and the absence of effective control. The annual losses caused are estimated to be about £1¼ million. In the last few years, however, experimental control measures carried out in some parts of the country [*cf. R.A.E.*, A **28** 57] have aroused public interest, and the author has compiled this book to meet the general need for information on the habits of the pests and practical means of eradicating them. It is divided into two main sections, of which the first deals with the biology and control of some 35 species of pests, grouped under the products attacked. These comprise: stored grain; tobacco; cacao, chocolate and sugar products; hides and wool; dried fruit; cocoons of the silkworm [*Bombyx mori*, L.]; and dried meat and fish. All stages of most of the pests are described and notes are given on their distribution in Bulgaria and elsewhere, and on the character of the damage they cause. The second section is devoted to measures for control. The best methods of handling and storing the crops, and the use of physical measures, such as exposure to heat or cold, are surveyed, notes are given on the properties and preparation of insecticides used as sprays or dusts, and fumigants and their application are discussed in considerable detail. An extensive bibliography is appended.

Boyko (A. K.). **Larva of *Senotainia tricuspis* Meig. causing heavy Losses of Bees.** [*In English.*]—*C. R. Acad. Sci. URSS* **24** no. 3 pp. 304–306. Moscow, 1939.

In some parts of the Ukraine, honey bees often die in large numbers when wild thyme (*Thymus serpyllum*) is in bloom, and it has been suggested that the nectar of its flowers is injurious to them, though it is not so in other localities. Investigations on the subject were carried out by the author in 1937 and 1938, and a living Sarcophagid larva was found in the thorax in a high percentage of the dying and dead bees. The larvae, which are briefly described, partly or wholly destroyed the thoracic muscles of the bees. In one instance, larvae found in bees from a very severely affected colony gave rise to adult flies, which proved to be *Senotainia tricuspis*, Mg., a common species of which the biology was unknown. The larval stage lasted 8–11 days, and the pupal stage 12–18. In the case of two of the bees, which were apparently healthy, an egg was found in the fibres of the thoracic muscles, a fact that is difficult to explain, as the ovipositor of *S. tricuspis* is not chitinous and would therefore be unable to pierce the bee's thorax. It is possible that allied Sarcophagids may have been the parasites in some cases. The actual numbers of bees killed cannot be estimated, as many of them die in the open. It is possible that the flies normally occur in the sandy areas where wild thyme grows and so chiefly parasitise the bees that visit the flowers of this plant.

[Fedorov (S. M.).] **Федоров (С. М.). On Biology of Grape** *Phylloxera.* [*In Russian.*]—*Proc. Lenin Acad. agric. Sci. U.S.S.R.* 1939 no. 7 pp. 24–28, 19 refs. Moscow, 1939.

The author records observations on the biology of *Phylloxera* [*vitifoliae,* Fitch] on European vines in the Ukraine that do not accord with previous views. Grassi considered that the Aphids that emerge from the leaf-galls (neogallicolae) belong to two morphologically distinct forms, gallicolae and radicicolae, of which the former produce new leaf-galls whereas the latter migrate to the roots [*cf. R.A.E.*, A **3** 764]. It was also believed by some authors that alatae are produced only on the roots and not on the leaves. In the author's observations, the characters used by Grassi and Grandori to differentiate the two forms were extremely variable and did not justify such a distinction. All the apterous parthenogenetic females (fundatrices, neogallicolae and neoradicicolae) were able to develop either on the roots or on the leaves, depending on ecological conditions, and alatae were produced in galls on the leaves. Neoradicicolae produced galls on the leaves in late June, July and August. Of 500 leaf-galls examined in October 1938, 80–90 per cent. contained up to 52 Aphids. In each gall only 1–4 were apterous adults, the rest being immature alatae. The galls are inhabited until the end of the season and do not perish with the fundatrix. The author therefore concludes that the production of nymphs in the leaf-galls is a common occurrence and that the Aphid is able to continue its development independently on the leaves as it does on the roots.

There is no evidence that *P. vitifoliae* is becoming anholocyclic on European vines. The number of ovarioles in autumn females was only one-third to one-fourth as great as in spring individuals, and the numbers of eggs laid were correspondingly reduced. Parthenogenetic reproduction was not continuous, but eventually resulted in the production of sexual forms, from the eggs of which fundatrices hatched in spring. In the Ukraine, infestation of the leaves is becoming increasingly frequent and occurs on many more varieties of European vines than was formerly the case.

FRANSEN (J. J.). **Voor en nadeelen van stuiven in land-, tuin- en boschbouw. (Een jaar ervaring met den motorbestuiver van de Nederl. Heide Mij.)** [The Advantages and Disadvantages of Dusting in Agriculture, Gardening and Forestry. (One Year's Experience with the Power Duster of the Nederlandsche Heide Maatschappij.)]—*Landbouwk. Tijdschr.* **50** no. 613, repr. 8 pp. [Wageningen] 1938. [Recd. 1939.] (With a Summary in German.)

The author discusses the advantages and disadvantages of using dust insecticides instead of sprays with particular reference to conditions in Holland, where treatment is generally confined to small areas, and concludes that the disadvantages of dusting have been overestimated. Contact dusts can be applied in cold weather, under which conditions an arsenical spray would be ineffective, and even rain falling a few hours after dusting is not detrimental in the case of a quick-acting poison.

FRANSEN (J. J.). **Biologische waardebepaling van de ter bestrijding van schadelijke insecten gebezigde aanrakingsvergiften.** [The biological Evaluation of the Contact Poisons employed to combat Insect Pests.]—*Landbouwk. Tijdschr.* **51** no. 624 pp. 312–362, 17 figs. [Wageningen] 1939.

The author gives the results of investigations in Holland on the most economical employment of contact dust insecticides. The apparatus used for ascertaining the minimum lethal doses is described [*R.A.E.*, A **26** 253]; in it, the dust is evenly applied over an area of 625 sq. cm.

Tests with batches of 100 newly hatched larvae of *Nygmia phaeorrhoea*, Don., on oak leaves were made in August 1937 with pyrethrum dusts of varying pyrethrin contents. Complete mortality was given by a dust containing 0·075 per cent. pyrethrins when it was applied at the rate of only 20 mg. per 625 sq. cm. (equivalent to about 3 lb. per acre), so that the use of a dust of greater pyrethrin content would be uneconomical. With weaker dusts, the percentage mortality varied with the amount applied, and the same result could be obtained with a small quantity of dust of high concentration and a larger quantity at a lower concentration. A table shows the minimum doses of pyrethrins (calculated in mmg. per sq. cm.) that gave 100 per cent. mortality of young larvae of *N. phaeorrhoea* when dusts of varying pyrethrin contents were applied at various rates. The minimum lethal dose was least (0·01) when dusts of 0·0125, 0·00625 and 0·00313 per cent. pyrethrin contents were used (the rates of application required being 50, 100 and 200 mg. per 625 sq. cm., respectively) and increased for stronger or weaker dusts.

On the basis of the prices obtaining in Holland for pyrethrum powder and talc, the most economical mixture to use against *N. phaeorrhoea* would be a dust of 0·05 per cent. pyrethrin content (for which the minimum lethal dose was 0·024) applied at the rate of

4·5 lb. per acre, but in the field the uniform distribution of so small a quantity is impossible. For practical work, it is necessary to use a dust of 0·00313 per cent. pyrethrin content at the rate of 30 lb. per acre. This concentration is near the permissible limit of dilution, and a weaker one is inadvisable, because a thicker layer of dust on the surface of the insect does not necessarily result in an increased number of particles of the poison coming into contact with the integument. With naked larvae, which have a small surface, the limit of dilution is soon reached. This is demonstrated in a table showing the effect on almost full-fed larvae of *Diprion pini*, L., of a dust containing dinitro-ortho-cresol. A mortality of 100 per cent. was obtained with 75 mg. of an 8 per cent. dust, whereas it was only 40 per cent. with 300 mg. of a 2 per cent. dust. The results of dusting are sometimes obscured by a toxic effect of the carrier. Thus, in one test, talc at the rate of about 135 lb. per acre gave complete mortality of newly hatched larvae of *N. phaeorrhoea*.

The minimum lethal dose of pyrethrins is still far from the chemical limit of possible dilution, and it is suggested that further economy could be attained by grinding the powder to a still greater degree of fineness. Insects of which the degree of sensitiveness to pyrethrum is known provide a more convenient test of the insecticidal value of pyrethrum dusts than chemical analysis. Larvae of *N. phaeorrhoea* can be used for this purpose with advantage, since they appear just after the pyrethrum crop has been harvested. Particulars are given of the method to be followed in collecting samples of the flowers and estimating their pyrethrin content.

Similar tests on first-instar larvae of *N. phaeorrhoea* were made with derris, though on a smaller scale, because previous work had indicated that the overwintered larvae were less sensitive to it than to pyrethrum [*cf.* **26** 347]. The minimum lethal doses of rotenone (calculated in mmg. per sq. cm.) for powders with different rotenone contents are tabulated. With dusts containing 0·70, 0·35, 0·175 and 0·117 per cent. rotenone, the respective doses were 0·224, 0·280, 0·280 and 0·375, the rates of application being 20, 50, 100 and 200 mg. per 625 sq. cm. The limit of dilution is therefore quickly reached with rotenone. It is not improbable that the minimum lethal dose would be lower than 0·224 if the rotenone content of the dust were between 0·7 and 0·35 per cent. Various components combine to give derris its insecticidal effect, and while rotenone is the most important of these, it is not known how dilution affects the specific action of the others. From the figures given above, the most economical dust would be one containing 0·7 per cent. rotenone used at the rate of about 3 lb. per acre, but for technical reasons it is necessary to use 30 lb. at 0·117 per cent. rotenone content.

As the larvae of *N. phaeorrhoea* progress in growth, the minimum lethal dose increases. Thus, for overwintered larvae measuring 0·7 and 1·2 cm. in length, respectively, the minimum lethal doses in mmg. per sq. cm. were 0·03 and 1·08 for pyrethrins, 0·56 and 2·4 for rotenone and 9·6 and 29 for dinitro-ortho-cresol. The state of development of the larvae is therefore of importance with respect to the date of dusting.

Variations in susceptibility to these dusts were also observed in other Lepidoptera. For larvae of *Lymantria dispar*, L., the minimum lethal doses of pyrethrins and rotenone were 0·24 and 2·40 mmg. per sq. cm. for individuals 0·35 cm. long, 0·36 and 76·8 for those 2·5 cm. long, and

0·48 and 19·2 for those 3·9 cm. long. For larvae of the first two sizes, the minimum lethal doses of dinitro-ortho-cresol were 2·40 and 48·0. On the basis of cost, the first-instar larvae are best controlled by means of dinitro-ortho-cresol and older ones by pyrethrum. In the case of *Malacosoma neustria*, L., the minimum lethal doses of pyrethrins, rotenone and dinitro-ortho-cresol were 0·04, 1·2 and 2·4 mmg. per sq. cm. for examples 0·4 cm. in length and 0·36, 67·2 and 48 for those 3 cm. long. Further investigations showed that full-fed larvae of *Stilpnotia* (*Leucoma*) *salicis*, L., were very resistant to rotenone, but not to pyrethrum, a dose of 4·8 mmg. pyrethrins per sq. cm. sufficing to kill examples 3–3·5 cm. long. This would be obtained by applying 22·5 lb. per acre of a pyrethrum powder of 0·2 per cent. pyrethrin content. With derris it would be necessary to apply 45 lb. per acre of a powder containing 16 per cent. rotenone.

The author concludes that for a given insecticide there is no fixed relation between the quantities necessary to control the larvae of these insects in different stages of development, and still less between the necessary quantities of the active components of the various insecticides and a given developmental stage of any group of insects. Even the order of classification according to insecticidal efficiency does not remain the same for larvae of a given species during development, as is shown in a table giving the minimum lethal doses of pyrethrins and rotenone per gm. body weight for larvae of *N. phaeorrhoea*, *L. dispar* and *M. neustria*. Furthermore, the susceptibility of the larvae may vary owing to internal causes and weather conditions. In the case of *N. phaeorrhoea*, susceptibility to pyrethrum and derris decreases just prior to moulting and during hibernation, and increases during periods of fasting, which occur if warm weather in spring brings the larvae out of their nests before the buds are sufficiently open to provide food. Larvae of *L. dispar* and *M. neustria* that hatched early indoors from overwintered eggs were more susceptible to pyrethrum and derris and less so to dinitro-ortho-cresol than were larvae that hatched later in the field. Mortality due to dusting was not greatly affected by temperature, but was increased by dew or light rain either before or after the application of derris or pyrethrum. Dew and mist were especially favourable when larvae of *D. pini* were dusted. Heavy rain immediately after dusting with derris caused these larvae to recover from their paralysis, but drowned some individuals that fell to the ground.

In investigations on the toxicity of dusts prepared in different ways, Dusturan, which is made by soaking a carrier in pyrethrum extract and evaporating the solvent and which contains 0·2 per cent. pyrethrins, and Pyrocide, which is a similar preparation containing 2 per cent. pyrethrins [*cf.* **26** 725] and was diluted with talc to contain 0·2 per cent., were compared with a Dutch pyrethrum powder similarly diluted for the control of almost full-fed larvae of *L. dispar*. The best control was given by the last named.

Larvae that fall to the ground after dusting have little chance of recovery and are frequently destroyed by natural enemies. Furthermore, if the dust causes restlessness, the larvae come into further contact with the poison [**28** 109]. The speed with which death ensues varies greatly. In the case of the insects investigated, pyrethrum and dinitro-ortho-cresol acted quickly and caused deformation. Derris caused no deformation and acted slowly, which is an advantage if the larvae harbour endoparasites.

FRANSEN (J. J.). **De smakelijkheid van verschillende soorten iepen voor de iepenspintkevers.** [The Attractiveness of various Elms for the Elm Bark-beetles.]—*Landbouwk. Tijdschr.* **51** no. 626–627 pp. 435–523, 14 figs., 11 refs. [Wageningen] 1939. (With a Summary in German.)

In Holland, the fungus, *Ophiostoma* (*Ceratostomella*) *ulmi*, which causes elm disease, is transmitted only by the bark-beetles, *Scolytus scolytus*, F., and *S. multistriatus*, Marsh. In this paper, which is based on work carried out in 1929–36 by the Netherlands committee for the study and control of elm disease, the author summarises the results of investigations on the susceptibility of various European, American and Asiatic elms to infection by injection of the spores of the fungus, and discusses in some detail a variety of observations on factors influencing the attractiveness of elms to the Scolytids for maturation feeding. The factors considered include the position of the tree, the length of the stem, the shape of the crown, the density of the foliage and the physiological condition of the tree. Observations showed that both Scolytids feed on healthy elms, and that *S. scolytus* also readily attacks trees that are infected by the fungus. It is concluded that probably all species and varieties of *Ulmus* are acceptable to the Scolytids for maturation feeding. *U. pumila* was attacked by the greatest number of beetles for feeding, but was resistant to the fungus.

RAUCOURT (M.). **Les dépôts d'arsenic dans les prés-vergers à la suite des traitements insecticides.**—*Ann. Épiphyt. Phytogén.* **4** fasc. 4 pp. 589–598, 4 figs., 3 refs. Paris, 1938. [Recd. 1939.]

The following is based on the author's conclusions: Experiments with sprays of lead arsenate and aluminium arsenate on apple trees in grass orchards [*cf.* *R.A.E.*, A **23** 703] were carried out in Seine-et-Oise during 1935, when high rainfall between 20th May and 1st July was followed by a comparatively dry period lasting until 15th August. The quantity of arsenic on the grass immediately after treatment was 40–50 mg. As per sq. metre and 50–80 mg. per kg. If the treated plot had previously been scythed, as much arsenic was retained by the grass per unit of area and it was as persistent as on unscythed plots, and as the weight of grass in a given area was less, the amount of arsenic per unit of weight was greater. Grass scythed before spraying should therefore not be used for pasture until it has regained its normal height. In two successive tests, the quantity of arsenic retained by the grass fell in three weeks during which the rainfall was, respectively, 52·3 and 31 mm. to one-third and one-fifth of its previous value. It soon became the same on scythed and unscythed plots. During a dry period that began a fortnight after one of the treatments, the quantity of arsenic per unit of area did not vary. The toxic deposits on leaves and fruit did not decrease in absolute value except during rainy periods. The arsenic coverage given by the two applications appeared to be sufficient to protect the trees from leaf-eating caterpillars. To control the codling moth [*Cydia pomonella*, L.], it would have been necessary to make further treatments to counterbalance the reduction in toxic deposit due to the increase in the size of the fruit.

Feytaud (J.). **La question doryphorique au début de la campagne 1938.**—*Rev. Zool. agric.* **37** nos. 4 & 7 pp. 49–55, 97–103, 1 map, 1 graph. Bordeaux, 1938. [Recd. 1939.]

The situation regarding the Colorado potato beetle [*Leptinotarsa decemlineata*, Say] in France at the beginning of the 1938 campaign is reviewed, and the extent to which it has invaded neighbouring countries is summarised. It continued to spread during 1937 in the south-east, east and north [*cf. R.A.E.*, A **26** 5]. Infestation was recorded from four more Departments, and at the beginning of 1938 only two (Var and Alpes-Maritimes) were free [*cf.* **27** 350].

Since the invasion began in 1920, the greatest extension of the affected areas has occurred in years in which the period May–July was warm and relatively dry. During 1937 the degree of infestation and the severity of the damage varied considerably. Damage was almost everywhere due chiefly to larvae of the spring generation, since the dry weather prevailing from June to September caused the foliage of early varieties of potato to wither ; injury was slight in central and north-eastern France, but was more severe where the foliage of later maturing varieties was available during the summer, as in certain southern districts. Beetles were very abundant in the south-west, where the loss was greater than in preceding years, in the recently invaded areas on the north-western coast and in some localities in the south-east, where, however, two of the Departments that became infested during 1936 were still only slightly affected.

Zelensky (V.). **Contribution à l'étude de** *Rhyacia saucia* **Hbn. (Lépid. Noct.).**—*Rev. Zool. agric.* **37** nos. 7–8 pp. 103–112, 120–122, 1 fig. Bordeaux, 1938. [Recd. 1939.]

Descriptions are given of all stages of the Noctuid, *Peridroma* (*Rhyacia*) *saucia*, Hb., which attacks ornamental plants and vegetable and other crops in Morocco and frequently causes severe damage in spring and early summer. Investigations on its bionomics were carried out in the summer of 1938. In the insectary, the egg, larval and prepupal stages lasted 8, 30–41 and 2–3 days, respectively, the duration of the larval stage varying by as much as 10 days among individuals that hatched on the same day from a single egg-mass. In the field, the pupal stage lasted about 4 weeks in spring and 2 weeks in summer. Adults lived for 10–15 days when fed on honey-dew, and for 8–10 days without food. There appear to be at least three generations a year in northern Morocco, adults of which are active during April and early May, July and September, respectively.

The injury caused by the larvae is described in detail. On hatching, they remain in groups and feed by day, avoiding shade, on the upper surfaces of the leaves, but after the second instar they migrate to the lower leaves, which they eventually skeletonise. Towards the end of the fourth and during the fifth instar, some of the larvae bury themselves in the soil by day and feed only by night, some remain above ground but cease feeding by day, and others partly bury themselves by day, but continue to feed on leaves near the soil. The prepupal stage is generally passed in the soil at depths of up to 6 ins., and pupation occurs in cells excavated in the soil, if it is compact, or in cocoons constructed of soil particles webbed together. Pupae died if they were exposed to the sun.

The adults are active by night and shelter under leaves, etc., by day. A female that emerged on 8th, paired on 9th and died on 20th May, began oviposition on 14th May, the numbers of eggs laid on this and the succeeding days being 450, 240, 140, 152, 82, 40 and 8. The eggs were laid in groups of 15–450, or singly towards the end of the oviposition period.

BOUHÉLIER (R.). **A propos de la lutte contre** *Rhyacia saucia* **Hbn.**—*Rev. Zool. agric.* **37** no. 8 pp. 122–123, 1 ref. Bordeaux, 1938. [Recd. 1939.]

Owing to the similarity between the injury caused by *Peridroma* (*Rhyacia*) *saucia*, Hb., on vegetable crops and ornamental plants in Morocco and that due to other Noctuids, it is not always possible to determine the precise amount of damage caused by the former, though in view of its wide distribution its importance is believed to be considerable.

Young larvae from eggs deposited on the foliage of woody plants feed on the leaves on which they hatch, but the older larvae attack the lower leaves and stems of herbaceous plants. Control is complicated by the behaviour of the larvae [*cf.* preceding abstract] and by the variety of their food-plants. Dusts or sprays of sodium or barium fluosilicate are effective against young larvae. Collecting the larvae is ineffective unless repeated several times, and poison baits are often unsatisfactory since the factors influencing the periods during which the larvae are active are insufficiently known.

DUCASSE (G.). **Quelques observations sur une cochenille :** *Matsucoccus matsumurae*, **Kuwana.**—*Rev. Zool. agric.* **37** no. 9 pp. 129–133. Bordeaux, 1938. [Recd. 1939.]

Matsucoccus matsumurae, Kuw., was observed in France for the first time in 1935, when it occurred on *Pinus pinaster* (*maritima*), especially in deep crevices in the bark of large trees, at several localities over a fairly large area in the south-west. It was observed on the same species of pine in three fresh localities in 1937, and studies on its bionomics were carried out in 1938.

Females mature in the field as early as January and occur, singly or in groups of not more than 10, deep in the bark, whereas the male pupae are more superficially situated. Individuals of both sexes, especially males, were sometimes found in resin exuded as the result of attack by larvae of *Dioryctria splendidella*, H.-S. Under laboratory conditions, males survived only three days. After pairing, the females became immobile and secreted a covering of white waxy filaments under which the eggs were deposited. Two that paired on 20th February deposited 300 and 50 eggs, respectively, between 23rd and 28th February ; larvae hatched on 21st March from eggs laid on 23rd and 24th February, and two days later from those laid on 25th–28th. Eggs and males observed in one locality on 21st April differed from those found elsewhere, and probably represent a distinct variety or species. Young larvae died when placed on the bark of pine, but of others placed at the end of April on young pines in pots, some became fixed to the terminal bud or to the soft parts of the bark. In the field, large numbers occurred, often in vertical lines, near the sapwood under the bark of large pines. There are at least two larval instars, the first lasting about 3 months.

This Coccid was found only on large pines, on which it caused little damage, but it possibly occurs also in plantations of young trees or on small branches. It was present in large numbers on pines on an estate near Bordeaux where *Palaeococcus* (*Monophlebus*) *fuscipennis*, Burm., had been abundant during 1926–30 [*cf. R.A.E.*, A **21** 6]; only a few examples of the latter were observed in 1937, however, and these occurred in a section in which *M. matsumurae* was scarce. Observations in another district showed that the two species rarely occurred on the same trees, and it is suggested by J. Feytaud that *M. matsumurae* may be replacing *P. fuscipennis*.

ZELENSKY (V.). **Contribution à l'étude de *Laphygma exigua* Hbn. (Lépid. Noct.) au Maroc.**—*Rev. Zool. agric.* **37** no. 9 pp. 137–143, 1 fig. Bordeaux, 1938. [Recd. 1939.]

An account is given of investigations on the bionomics of *Laphygma exigua*, Hb., in Morocco, where this Noctuid attacks a large number of fruit, vegetable and leguminous fodder crops and sometimes causes considerable loss. The egg, pupa and five larval instars are described. In summer, the egg, larval and pupal stages lasted 3, 17–20 and 8–11 days, respectively. Adults survived for 3–4 days without food, and for 6–12 days when provided with honey-dew.

On hatching, the larvae remain under the hairs that protect the egg-mass and attack the leaf or stem on which it is situated; later they spin loose webs which cause the leaf edges to curl. They are active by day until the end of the third instar, after which they shelter under the leaves at the base of the food-plant, some feeding only by night. Pupation generally takes place underground within a cocoon made of soil particles, but the cocoon may be constructed on a stem in contact with the soil, or the larvae may pupate on the bare soil. Pairing and oviposition occur at night, usually about 24 hours after the emergence of the adults; the egg-masses, which contain 15–100 eggs in 2–4 layers separated from each other and covered by hairs from the female, are deposited on the upper surface of the leaves, or more rarely on their lower surfaces or on the stems.

BALDUF (W. V.). **The Bionomics of Entomophagous Insects. Part II.** —Demy 4to, [4] 384 pp., 228 figs., 36 pp. refs. St. Louis, J. S. Swift & Co., 1939.

This monograph, which is the second of a series on the bionomics of insects that feed on other insects [*cf. R.A.E.*, A **24** 154], deals with Lepidoptera, Trichoptera, Mecoptera and Neuroptera. It contains a digest of the literature on the subject in all languages and is based on references from the *Zoological Record* and data obtained from Series A of this *Review* up to and including the volumes for 1936. The general features of each Order are given, and are followed in the case of Mecoptera and Neuroptera by discussions of individual families, while Trichoptera are discussed as a whole. The section on Lepidoptera is divided into three parts; the first deals with general features and families other than LYCAENIDAE as a whole, the second with LYCAENIDAE, and the third with the development of entomophagy in the Order. Special attention is given to the activities of the several stages of the entomophagous families and species, particularly their food and feeding habits, but it was found necessary to include the bionomics of certain non-entomophagous forms in the three Orders that are not exclusively carnivorous. The extensive bibliography, to which reference is made throughout the text, is divided into groups to be found at the ends of the first two parts of the section on Lepidoptera and at the ends of the other sections.

WEHRLE (L. P.). **A new Insect Introduction.**—*Bull. Brooklyn ent. Soc.* **34** no. 3 p. 170. Lancaster, Pa., 1939.

Weevils found infesting fenugreek (*Trigonella foenum-graecum*) and lucerne (*Medicago sativa*) in Arizona on 11th April 1939 were identified as *Hypera brunneipennis*, Boh., which was originally described from Egypt and is not known to have been previously recorded from the United States. Larvae, pupae in cocoons and adults were collected at intervals during the following two weeks, and feeding was observed on both lucerne and sour clover (*Melilotus indica*) in fields and on ditch banks on both sides of a road for a distance of about 8 miles.

JONES (T. H.). **Cankerworms.**—*Leafl. U.S. Dep. agric.* no. 183, 8 pp., 5 figs. Washington D.C., 1939.

A brief account is given of the life-history and distribution in the United States of the cankerworms, *Alsophila pometaria*, Harr., and *Paleacrita vernata*, Peck, the larvae of both of which defoliate a considerable variety of deciduous forest, shade and fruit trees. Control measures include preventing the females from ascending the trees by means of sticky bands [*cf. R.A.E.*, A **13** 25; **24** 14] and spraying with lead arsenate when the leaf buds are unfolding. The spray now recommended contains 3 lb. powdered lead arsenate and 12 oz. fish oil or linseed oil in 100 U.S. gals. water [*cf.* **27** 28].

PARKER (J. R.). **Grasshoppers and their Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1828, 37 pp., 27 figs. Washington, D.C., 1939.

This bulletin on the most injurious grasshoppers in the United States and their control supersedes one already noticed [*R.A.E.*, A **27** 240] of which it is a much enlarged revision. The species dealt with are *Melanoplus mexicanus*, Sauss., *M. differentialis*, Thos., *M. bivittatus*, Say, *M. femur-rubrum*, DeG., and *Camnula pellucida*, Scudd. Sections have been added on the regions in which severe damage by grasshoppers occurs, the extent of losses caused, the nature of the injury and the manner in which outbreaks develop.

Maize cobs ground to the consistency of coarse bran, ground cottonseed hulls [**26** 139, 574] and maize stalks are suggested as substitutes if the use of sawdust in baits is not practicable. Ploughing [**20** 430] to a depth of at least 5 ins. followed by packing prevents the emergence of young hoppers from the ground, but shallow cultivation, though it may result in large numbers of eggs being killed, is not reliable, as its success depends on prevailing weather conditions. Seed of small grain crops should be sown only on land that has been ploughed in autumn or spring, or summer-fallowed.

EBELING (W.). **Host-determined morphological Variations in** *Lecanium corni.*—*Hilgardia* **11** no. 11 pp. 613–631, 5 figs., 5 graphs, 13 refs. Berkeley, Calif., 1938. [Recd. 1939.]

The effect that different food-plants may have on the morphological characters of an insect species was studied in California on *Lecanium corni*, Bch., which was selected because it presents a great variety of forms on the numerous plants it infests. This has led to some confusion of names ; the resulting synonymy is briefly reviewed, and a detailed description is given of the adult female as it occurs on its commoner food-plants, such as *Prunus*. To determine to what extent its morphology is influenced by the food-plant, variations were studied in the size and structure of the antennae and legs, and in the body proportions of mature gravid females taken from the leaves of Christmasberry (*Photinia arbutifolia*) in three widely separated localities with a great diversity of climate, and also from leaves of apricot (*Prunus armeniaca*) in three different environments. On the basis of different structural ratios, such as the ratio of the length of the antennae to that of the body, the ratios of the lengths of antennae or leg segments to one another or to the length of the entire appendage, or of the height of the entire insect to its length, certain morphological differences were evaluated statistically. Individuals from apricot had large bodies and short appendages, whereas in those from Christmasberry the reverse was observed.

L. corni has one generation a year, and in southern California the eggs hatch in early spring. In field experiments in the spring of 1933, in which apricot twigs heavily infested by gravid females were attached to uninfested shrubs of Christmasberry, large numbers of young scales migrated to the latter and settled on the leaves and in the autumn some migrated to the branches. Adults observed in the following spring showed the structural characteristics of the Christmasberry form. The progeny of adults taken on alder (*Alnus rhombifolia*) in the field in June 1934 and transferred to apricot in the laboratory reached maturity in the spring of 1935 and closely corresponded in size and structure to individuals occurring naturally on apricot.

BASINGER (A. J.). **The Orange Tortrix,** *Argyrotaenia citrana.*—*Hilgardia* **11** no. 11 pp. 635–669, 11 figs., 5 graphs, 19 refs. Berkeley, Calif., 1938. [Recd. 1939.]

Serious damage to the fruits of orange and occasionally other species of *Citrus* in southern California is caused by the larvae of the Tortricid, *Eulia* (*Argyrotaenia*) *citrana*, Fern., which is widely distributed and occurs in all the important *Citrus* areas. It is particularly abundant in localities situated in the coastal region, where it produces several overlapping generations a year, all stages being present simultaneously, whereas in districts further from the coast there are only two distinct generations. Its food-plants include some 40 species of several different families, a list of which is given. All stages are described.

In the laboratory, at temperatures of 58–78°F., males and females lived for an average of 29 and 21 days, respectively, when fed on honey and water, and 8–10 days when kept without food and water. The moths are sexually mature on emergence or soon after and starved adults reproduced normally. Larger individuals laid more eggs ; thus, the total numbers of eggs deposited by the smallest and largest female of a batch reared at 55°F. were 153 and 428. The eggs are laid in batches on both surfaces of green leaves, or on fruits and smooth green twigs, and the incubation period varies with temperature ; in the field it may last 8 days in summer and 20 or more in winter. Practically all eggs hatched under field conditions.

The larvae are solitary and live in nests, which are usually made by webbing together unfolded leaves on young tips ; they sometimes occur among the buds and blossoms, and when the blossoms fall, dried petals and pistils occurring on leaves and in fruit clusters are also webbed together ; many shelter under the sepals of newly set oranges. The larvae usually feed on tender foliage, fresh buds and the ovaries of the blossoms and on fruits in all stages of development. During the late summer and autumn they feed on dead leaves and blossoms. Conditions are most favourable in the cooler months from November to June, the larvae being then most active and vigorous, and consequently causing more damage than in the summer, when hot dry weather causes them to feed very little and to develop slowly. The range of constant temperatures at which the larvae could develop extended from about 45 to 85°F., at which extremes 78 and 56 per cent. of them, respectively, pupated. At 35°F. they died without feeding, and at 95°F. they survived for only about 4 days. The duration of the larval stage depends on temperature and humidity. Thus, in the laboratory, larvae reared at 75 or 85°F. and 70 per cent. relative humidity reached the pupal stage in 20·9 and 25·7 days, respectively, while those reared at 75°F. and 35 per cent. humidity required 29 days. Under conditions of high temperature and low humidity, which occur in the field towards the end of summer and the beginning of autumn, larval activity is greatly reduced and development protracted. This is particularly pronounced in the interior districts of southern California where the larval stage from hatching to pupation was observed to last about 7 months. Pupation takes place in a cocoon in the last larval nest. The length of the pupal stage varies, primarily with the temperature, from 8–10 days in summer to 3 weeks in winter. It was retarded by low relative humidity.

The damage caused to oranges by the larvae is discussed at length. The scarring that results from the superficial feeding of young larvae on small fruits in the spring is of minor importance, but fruits injured by older larvae, which tunnel through the peel into the juice cells, soon start to decay and either drop or become mummified on the tree. Holes made by small larvae are difficult to detect, but if injured fruits are packed, they decay in the boxes. In cases of heavy infestation the crop may be reduced by as much as 40 per cent. A population of 50–100 or more larvae on a 20-year-old tree is sufficient to cause severe damage, especially if the fruits are abundant, because they are then closer together and form clusters.

Of the 12 parasites of *E. citrana* that were observed, the commonest in order of descending importance were *Apanteles aristoteliae*, Vier., *Zele* (*Hormius*) *basalis*, Prov., *Exochus* sp. and an undescribed Ichneumonid of the genus *Omorgus* (*Campoplex*). Females of *A. aristoteliae* oviposited in host larvae in all instars. The adult, larva and pupa are described. *Z. basalis*, of which the egg and adult are described, is ectoparasitic and required 50 days to complete development at outdoor temperatures in November–January, exclusive of the incubation period. *Exochus* sp., which occurs in both the coastal and interior region, is commonest from February to June. The egg is laid in the body cavity of the host larva, and the adult parasites emerge from the host pupa.

Other Lepidoptera that occur on orange in California are *Holcocera iceryaeella*, Ril., which often accompanies *E. citrana*, and is more abundant in the coastal belt than in the interior, *Platynota stultana*, Wlsm., which is less common, and *Pyroderces rileyi*, Wlsm., which attacks *Citrus* in San Diego.

SIEVERS (A. F.) & SULLIVAN (W. N.). **Toxicity of *Tephrosia*. A Study of the Toxicity of *Tephrosia virginiana* Roots prepared by several Methods.**—*Soap* **15** no. 9 pp. 111, 113. New York, N.Y., 1939.

In connection with investigations on *Tephrosia virginiana* as a possible source of rotenone for insecticides, tests with acetone and chloroform extracts prepared in various ways were carried out on flies [*Musca domestica*, L.] by the Campbell-Sullivan turntable method [*cf. R.A.E.*, B **26** 246] to determine whether their toxicity is reduced by extraction on a hot plate, removal of the solvent by heating in determining the total extract and similar procedures in which the extract is subjected to heat. A comparison of the results with those obtained with extracts made by simply shaking the root in acetone or chloroform showed that the differences were not significant.

MUESEBECK (C. F. W.). **A new Mealybug Parasite (Hymenoptera: Scelionidae).**—*Canad. Ent.* **71** no. 7 pp. 158–160, 1 fig. Guelph, 1939.

This paper includes descriptions of both sexes of the Scelionid, *Allotropa utilis*, sp. n., which was bred from *Phenacoccus aceris*, Sign., in Nova Scotia during 1933–37 [*cf. R.A.E.*, A **23** 681].

GILLIATT (F. C.). **The Life History of *Allotropa utilis* Mues., a Hymenopterous Parasite of the Orchard Mealy Bug in Nova Scotia.**—*Canad. Ent.* **71** no. 7 pp. 160–163, 1 fig. Guelph, 1939.

In this posthumous paper, an account is given of studies carried out during 1936–37 on the bionomics of the Scelionid, *Allotropa utilis*, Mues. [see preceding paper], which is an important parasite of *Phenacoccus aceris*, Sign., on apple in Nova Scotia, where it was observed shortly after the discovery of the latter in 1932 [*R.A.E.*, A **23** 680]. The egg and larva and the processes of oviposition and embryonic development are briefly described.

Nymphs of *P. aceris* began to hatch in the orchard in late June, only a few days before the adults of *A. utilis* emerged, and the populations of newly hatched nymphs and adult parasites reached their maxima at almost the same time during July ; a graph shows the dates (between late June and early August) on which the nymphs of the Coccid hatched and the adult Scelionids emerged during the two seasons. Only 72 of a total of 500 parasites examined during 1937 were females. They were observed to oviposit freely in the field on 23rd July 1937. The egg was generally deposited in the dorsal surface of the abdomen of the nymph, but, sometimes, owing to the movement of the latter, in its ventral surface. Females appeared to show some discrimination in the selection of a host, and 58 per cent. of the parasitised nymphs examined contained only one egg. Two or three eggs, generally in different stages of development, were frequent in the remaining nymphs, a few of which contained as many as five, but there was no indication of polyembryony. The parasites attacked an average of about three hosts in half an hour.

In 1937, adults of *A. utilis* began to emerge on 30th June, and dissections of parasitised nymphs showed that the first larva hatched 36 days later. Eggs were still observed in the hosts on 5th October. The larvae develop freely in the body cavity of the host, with the head towards the posterior end, and the first to hatch were in a less advanced stage of development than those that hatched later. When they are fully-fed, the bodies of their hosts become barrel-shaped and the appendages degenerate ; this condition was first observed about the middle of September, but was not reached by all the parasitised nymphs until the end of October. The larvae overwinter within the exoskeletons of the hosts ; these generally occurred in crevices or under the bark, covered by a small quantity of waxy filaments secreted by the nymphs after they had migrated from the foliage, but a few were found on the leaves. Pupation takes place in spring, and the adults begin to emerge about the end of June.

The percentage of nymphs parasitised varied from 2–15 in orchards in which the host was scarce to 50–66 in those in which it was abundant.

Pests and Diseases.—*Rep. Dep. Agric. British Honduras 1938* p. 3. Belize, [1939].

Aspidiotus destructor, Sign., appeared to be increasing on coconut in British Honduras in 1938, and was found on most of the plantations.

[KAMENSKIĬ (S. A.) & MENDE (V. N.).] **Каменский (С. А.) и Менде (В. Н.). Effect of Temperature and Moisture on the Development of the Beet Weevil.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 3–28, 4 graphs, 13 refs. Leningrad, 1939.

A detailed account is given of laboratory and field observations on *Cleonus* (*Bothynoderes*) *punctiventris*, Germ., carried out in 1937 and 1938 in the Province of Kiev where it causes severe damage to sugar-beet. The technique by which the weevils were reared is described. The resistance to cold of adults that had not fed was studied in winter by exposing them to frost for various periods. Of individuals kept in the open for 91 days at a mean temperature of −3·8°C. [25·16°F.] with a minimum of −25°C. [−13°F.], 28 per cent. survived. Weevils that had fed were much less resistant to cold, probably because they contained a larger amount of free water in the body [*cf. R.A.E.*, A **25** 571]. Of eggs exposed for 24 hours to temperatures of −10 to −25°C. [14 to −13°F.] or for 6 days to a mean temperature of −9·8°C. [14·36°F.], 30 and 20 per cent. survived, the percentage mortalities in the controls being 15 and 46. Of newly hatched larvae exposed for 20 hours to temperatures between −3 [26·6°F.] and −10°C., 60 per cent. survived. Pupae were not affected by exposure to −3°C.

The effect of various temperatures on the activity of the weevils is shown in tables. The optimum zone was between 25 and 35°C. [77–95°F.]. The weevils began to move about in the soil at 7°C. [44·6°F.], and started to feed at 8·5°C. [47·3°F.]. The lower thermal limit for sexual maturation occurred at 18°C. [64·4°F.] and the upper at a constant temperature of 44°C. [111·2°F.]. If, however, temperatures higher than this were alternated every 24 hours with low temperatures, maturation and oviposition took place. Experiments showed that an alternation of high and low temperatures enabled the weevils to develop normally at mean temperatures that they would not have survived had they remained constant. Under such conditions, the weevils matured more rapidly, lived longer, fed more intensely and deposited more eggs. This beneficial effect was observed even when the high temperatures only occurred for short periods, and shows the importance for the weevils of solar radiation and high temperatures on the surface of the soil.

In some individuals, oviposition was intense and of short duration, and in others interrupted or protracted, sometimes continuing for as long as 180 days. The maximum number of eggs laid by a female in 24 hours was 60. Under optimum conditions of temperature and humidity (26·2°C. [79·16°F.] and 30–37 per cent.), females survived for an average of 102·7 days, and the average and maximum numbers of eggs deposited were 361·8 and 755. Longevity and fertility were greatest at a relative humidity of 30–40 per cent., especially at 25°C. ; higher humidities were detrimental, and at 100 per cent. practically all females died without ovipositing. The ability of the weevils to survive starvation varied inversely with the temperature and directly with humidity. In the Province of Kiev, where the mean temperature of the air and soil in April–May does not exceed 15°C. [59°F.], the weevils should be able to survive without food for two months or more, until their wild food-plants appear or beet begins to sprout. Prolonged starvation before feeding, however, reduces longevity and fertility. Females that lost at least 30–35 per cent. of their initial weight through starvation did not oviposit or live long even under optimum conditions. The development of the weevils was also affected by the quality of the food ; the length of the period of maturation varied with its water-content. Thus, weevils that fed on young leaves or juicy stems of beet matured twice as rapidly as those that fed on the roots or old leaves.

The eggs developed within a wide range of temperatures and humidities. Some survived exposure for one hour to 60°C. [140°F.]. At humidities of 90–100 and 55 per cent., mortality was lowest at 25–30 and 20–25°C. [77–86 and 68–77°F.], respectively. High temperatures combined with low humidity increased the rate of mortality and retarded hatching. Though contact with water was not essential for embryonic development, it shortened the period over which the eggs hatched.

Larval survival in the first and second instars is dependent on rapid development, and is thus favoured by high temperatures. At 38·9°C. [about 102°F.], these instars were completed in means of 5·8 and 7 days. At 7–15°C., first-instar larvae survived for 30–45 days and entered the roots of beet, but did not develop. Third-instar larvae were very sensitive to lack of food and less so to temperature conditions. Those in the fourth and fifth instars were the most resistant to unfavourable conditions. At 25·9°C. [78·62°F.] and a relative humidity of the soil of 15·6–31·2 per cent. (its moisture capacity being 52 per cent.), the larval stage lasted 41–74 days. The prepupal stage usually lasted 3–8 days under optimum conditions, but was sometimes prolonged to 18 days.

The pupae, which usually occur at depths of 8–12 ins., where humidity of the air is always 100 per cent. and day fluctuations of temperature are insignificant, were able to withstand exposure to

20 and 40 per cent. relative humidity, though at 18·5°C. [65·3°F.], the percentage mortality averaged 78·5 and 52·6, respectively, and the weevils that emerged were deformed. At these humidities and temperatures of 29·9 and 30·4°C. [85·46 and 86·72°F.], respectively, the percentages fell to 30 and 40. Pupae were able to absorb moisture from without ; those placed on damp cotton-wool increased in weight by 10–15 per cent. and gave rise to adults normally even under conditions of dry heat. Pupal development was shortest (8·8 days) at 30°C. and mortality was lowest at about 25°C. The pupal stage averaged 9·2 days at about 40°C. [104°F.], but the percentage mortality was 60. The thresholds of development for the different stages of the weevil and the sums of effective temperatures are given ; they do not differ greatly from those already noticed [**26** 237].

On the basis of these investigations and data in the literature, the author concludes that outbreaks of *C. punctiventris* cannot occur in years in which there is abundant rainfall in May–June, as both temperature and humidity would then be detrimental to the maturation of the adults and the development of the young larvae.

[ALEKSANDROVSKAYA-IVANOVA (Z. V.).] **Александровская-Иванова (З. В.). The Application of Vivianite for the Control of Granary Pests.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 37–47, 14 refs. Leningrad, 1939. (With a Summary in English.)

With a view to the discovery of substances that would protect stored grain from damage by pests and would not be poisonous to man, laboratory experiments were carried out in Moscow in 1934 with various materials that are used as fertilisers. Of the dusts that proved effective against weevils and mites, special attention was devoted to vivianite, which is a hydrated ferrous phosphate with the formula $Fe_3(PO_4)_2 8H_2O$ that is found in many parts of the Russian Union and frequently occurs in peat bogs, where it is considered to lower the quality of the peat. It is seldom found pure and usually contains admixtures of peat. It is very cheap and does not require any special treatment before application, except drying in the air and sifting.

To test its toxicity, wheat grains of which the moisture content was 15·5–17 per cent. of their dry weight were artificially infested with *Calandra granaria*, L., and the mites, *Tyroglyphus* (*Aleurobius*) *farinae*, DeG., *Glycyphagus cadaverum*, Schr., and *Cheyletus eruditus*, Schr., and mixed with the dust in different proportions. Examinations of the grain at intervals of five days showed that treatment with vivianite at the rate of 1 part per 1,000 by weight of grain greatly reduced the numbers of mites within 5 days and killed all the weevils and mites in 25 days. Only a few eggs of the mites survived. These results were confirmed with grain that was naturally infested by mites and the weevil. Though larvae and pupae of *C. granaria* inside the seeds gave rise to adults, the latter died within about 25 days of emergence.

Other tests showed that the toxicity of vivianite decreased as the dust contained a greater admixture of peat ; to secure effective control of granary pests, it should not contain more than 40 per cent. of peat dust. In experiments with artificially infested grain of which the moisture content varied from 15·5 to 27 per cent. and which was kept after treatment for periods ranging from 5 to 30 days at temperatures of 8–10°C. [46·4–50°F.], 18–20°C. [64·4–68°F.] or 25–30°C. [77–86°F.], vivianite was more effective in proportion as the grain was drier, but its toxicity was not affected by the temperatures at which the grain was kept or by the size of the treated seeds.

Treatment of rye and oats severely infested by all stages of the mites in granaries in August 1935 gave very successful results when vivianite was used at the rate of 1 per cent. by weight for the oats and 0·5 per cent. for the rye. The grain was mixed with the dust for 3 minutes in a machine used for treating it with fungicides, or was dusted and turned over for 20 minutes with spades and was then stored in sacks. The treated grain was found to be free from mites 3 months later, whereas control lots were heavily infested. The germination and growth of wheat of normal or increased moisture content (14·8 and 18·9 per cent.) were not affected by treatment, even after storage for a year.

Vivianite was harmless to rabbits that consumed 7 oz. of dusted wheat daily, and men were not affected by eating daily for about 6 weeks ½–3 lb. bread baked from the flour from wheat treated at the rate of 0·5 per cent. The loaves baked from such flour were of normal appearance, quality and taste.

[ZAMBIN (I. M.).] **Замбин (И. М.). The theoretical Basis of the Distribution of harmful insects and of Predictions as to their Mass Multiplication. [VI.] The Resistance to Cold of the Eggs of the Migratory Locust** (*Locusta migratoria* **L.**). [*In Russian.*]—*Plant Prot.* no. 19 pp. 48–55, 2 graphs, 10 refs. Leningrad, 1939. (With a Summary in English.)

In the Russian Union, *Locusta migratoria*, L., passes the winter in the egg stage, and many of the eggs are killed by the very low temperatures to which they are exposed. Experiments showed that the resistance of the embryos to low temperature decreases as they develop. Continuous exposure to −21°C. for 24 hours did not cause mortality before the blastokinetic stage, but embryos ready to hatch were killed by 24 hours' exposure to −11°C. [12·2°F.]. Repeated short-period cooling and warming reduced resistance. It was also reduced by contact moisture, and eggs in the stage just after blastokinesis placed in water were killed by exposure for 4 hours to −11°C. The water content of eggs in nature was found to vary with soil humidity and to increase as embryonic development proceeded. The fat-content of the eggs decreased, and the glucose content increased, with development.

[SHCHEPETIL'NIKOVA (V. A.).] **Щепетильникова (В. А.). On the Rôle of Temperature and Humidity in the Biology of** *Trichogramma evanescens* **Westw.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 56–66, 1 graph, 16 refs. Leningrad, 1939. (With a Summary in English.)

The literature on the effect of temperature on the development of *Trichogramma* is reviewed [*cf. R.A.E.*, A **5** 156; **14** 501; **16** 43; **24** 266], and a detailed account is given of experiments carried out in 1936 with the Azov-Black-Sea race of *T. evanescens*, Westw. [*cf.* **27** 589] reared on eggs of *Sitotroga cerealella*, Ol., at combinations of average temperatures of 22·3, 25·3, and 28·3°C. [72·14, 77·54 and 82·94°F.] and relative humidities of 40–45, 60–65, 75–80 and 90–95 per cent. The results showed that low humidity, irrespective of temperature, was unfavourable, as the host eggs tended to dry up, fewer parasites emerged and their egg production was reduced. At 22·3°C., the numbers of females that oviposited and the numbers of eggs that were deposited and that hatched were greatest at humidities ranging from 75 to 95 per cent., whereas at the higher temperatures the zone of favourable humidity was narrower (75–85 per cent.). At 90–95 per cent. humidity, there was a marked reduction in the numbers of eggs deposited and fewer hatched, especially at 28·3°C.; under these conditions, the eggs of *Sitotroga* frequently became mouldy, which also impeded the development of *Trichogramma*.

The effect on the parasite of average temperatures ranging from 9·5 to 37°C. [49·1–98·6°F.] was studied at the favourable humidity of 75–80 per cent. The lowest numbers of eggs were laid at 13·5 and 32·1°C. [56·3 and 89·78°F.], and females did not oviposit at 10 and 35°C. [50 and 95°F.], which indicates that the lower threshold of development is between 10 and 13°C. [55·4°F.] (theoretically at 10·2°C. [50·36°F.] as calculated by Blunck's formula) and the upper limit at about 35°C. The total number of eggs deposited increased sharply at 18·7°C. [65·66°F.], and the highest average number (28·7) was deposited at 20·3°C. [68·54°F.], at which temperature the average number of adult progeny per female was also highest (27·9). The number of eggs deposited and of adult progeny gradually decreased at higher temperatures, and fell sharply at 32°C. [89·6°F.].

The duration of the life-cycle was not affected by atmospheric humidity, but varied with the temperature. At a mean temperature of 13·5°C. it averaged 40·5 days, as compared with 15·5, 14, 9·5 and 7·5 days at 20·3, 22·3, 28·3 and 32·1°C. From these figures and from those representing the total number of offspring resulting from a female at different temperatures and 75–80 per cent. relative humidity, it is calculated that the reduction in productivity of the females as the temperature rises is more than offset by the acceleration of the life-cycle, so that the productivity of a stock reared in the laboratory would be greatest at a mean temperature of 30°C. [86°F.]. As, however, this is very close to the thermal limit, mass-rearing in practice would be best carried out at 25–28°C. [77–82·4°F.] and a relative humidity of 75–80 per cent. The sum of effective temperatures necessary for the development of a generation was 162 day-degrees C. [291·6F.].

[LAPINA (V. F.).] **Лапина (В. Ф.). Dependence of Storage Period of** *Trichogramma evanescens* **Westw. upon Temperature and Humidity.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 67–73, 14 refs. Leningrad, 1939. (With a Summary in English.)

This is a fuller account of investigations already noticed on breeding *Trichogramma evanescens*, Westw., in eggs of *Sitotroga cerealella*, Ol., and *Ephestia kuehniella*, Zell., at various temperatures and humidities [*R.A.E.*, A **27** 589]. The investigations also showed that more females than males emerged if the host eggs were stored at low temperatures when containing mature larvae of *Trichogramma*, the respective sex ratio being 3 : 1 as compared with 1 : 1 in the case of eggs stored when containing pupae.

[IBATULINA (F. S.).] **Ибатулина (Ф. С.). Testing Methods for controlling the Garden Weevil.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 74–92, 2 graphs, 19 refs. Leningrad, 1939.

The experiments described were carried out in orchards in the southern Crimea in 1934 and 1935 and in the western part of the northern Caucasus in 1936 and 1937 with a view to working out a system of control measures against *Rhynchites bacchus*, L., *R.* (*Coenorrhinus*) *pauxillus*, Germ., and *Anthonomus pomorum*, L., which are important pests of fruit trees in the Russian Union. Since the emergence of the weevils from hibernation is protracted, and the peaks of adult activity and oviposition in each species do not occur simultaneously, it was important to determine the correct dates for the application of insecticides and the number of treatments required.

In 1934, dusting with calcium arsenate mixed with 7½ per cent. anabasine sulphate, or with a proprietary arsenical (Meritol), at rates of 13½ and 27 lb. per acre, respectively, proved effective against all three species on apple. Two applications are required against *R. pauxillus*, the first when the inflorescences just begin to show from under the burst scales of the buds, and the second when the individual flower-buds are becoming separated. In 1935, the percentage mortalities of this weevil obtained by applications at these times (17th and 26th April) were 30·7 and 45·5 with Meritol and 39·9 and 43·9 with calcium arsenate alone.

In the case of *A. pomorum*, one application of Meritol, calcium arsenate or barium fluosilicate, at rates of 27, 13½ and 27 lb. per acre, respectively, was effective, if carried out during the mass emergence of the young weevils from the infested buds, which usually occurs during the period of physiological shedding of the fruitlets. In 1935, calcium arsenate applied at this stage (3rd June) killed 94·8 per cent. of the weevils.

Dusting experiments against *R. bacchus* indicated that three applications of Meritol, calcium arsenate or barium fluosilicate are necessary on apple, the first about 7–9 days after petal fall, when the weevils are feeding voraciously and beginning to oviposit, the second during the period of intense oviposition, which usually coincides with the shedding of the fruitlets (about the end of May), and the third 7–10 days later. The last two applications of Meritol or calcium arsenate are also effective against first-generation larvae of *Cydia pomonella*, L., and young adults of *A. pomorum*. Barium fluosilicate was ineffective against *Cydia*. Stone-fruits should be dusted twice, in the case of apricots and plums when the fruitlets are 0·6–0·8 cm. long and *R. bacchus* is beginning to oviposit, and 5–6 days later.

In special experiments in 1937 on the control of *R. bacchus* on apple by sprays of 1 per cent. barium fluosilicate, good results were given by three applications, the first on 12th May, six days after petal fall, the second on 25th May, during the period of mass oviposition, and the third on 19th June. This programme reduced the percentage of injured fruits to 27·5 and the average number of punctures per apple to 1·08, as compared with 55·9 and 2·7 in the control, but the third application had been delayed by wet weather, and would probably have been more effective if it had been carried out on 5th June, while the weevils were still ovipositing.

Other measures recommended against the weevils are: clean cultivation of the orchards and the removal of weeds and shrubs; timely pruning of the trees against *R. bacchus*, which thrives in old neglected orchards and prefers trees with a dense crown; systematic collection every five days of fallen fruits, from the time when the fruitlets drop until harvest [*cf. R.A.E.*, A **25** 506], the fruits being buried at a depth of at least 20 ins.; raking up and destroying fallen leaves at the beginning of June to kill the larvae of *R. pauxillus* [**26** 621]; and jarring [**21** 634]. Trees should be jarred at intervals of 4–5 days from about mid-March until the beginning of flowering. They should also be jarred twice against *A. pomorum* in June, during the period when the young weevils abandon the buds. In view of the high temperatures that usually prevail at this time during the day, jarring is best carried out before dawn. It is recommended that infested buds of apple should be collected and kept for 10–12 days to permit the emergence of parasites. Up to 28 per cent. of larvae and pupae of *A. pomorum* are parasitised by *Habrocytus tenuicornis*, Först., and *Tetrastichus pospelovi*, Kurdj. In the autumn the trees should be jarred 4–5 times to reduce the numbers of adults of *R. bacchus* entering hibernation.

Trap-bands of straw or shavings against *A. pomorum* [*cf.* **19** 158] are usually effective only in orchards in low-lying damp localities, as in those on elevated or exposed ground the weevils avoid the bands and seek damper shelters such as shrubs. In damp cool years, however, many weevils are attracted to the bands irrespective of the situation of the orchard. Heaps of leaves placed near the base of trees to trap hibernating adults of *R. bacchus* are effective in dry autumns or in orchards on elevated ground ; if they become damp they are avoided.

[Pospelov (V. P.).] **Поспелов (В. П.). Use of the Diseases of Insects, as a Method of controlling agricultural Pests.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 93–107, 9 figs., 26 refs. Leningrad, 1939.

This is a review, based on the literature, of work carried out in different countries, particularly the Russian Union, on the control of insect pests by means of entomogenous fungi, bacteria and virus diseases. The ways in which the organisms can be disseminated are discussed, and it is considered that the microbiological method of controlling injurious insects will become of great economic importance.

[Meĭer (N. F.).] **Мейер (Н. Ф.). The predacious Mite** *Pediculoides ventricosus* **Newp.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 150–153, 4 figs., 10 refs. Leningrad, 1939.

In 1937, mass-rearing of *Trichogramma* [*evanescens*, Westw.] on eggs of *Sitotroga cerealella*, Ol., was prevented in most of the breeding laboratories in Russia owing to the appearance in them of the predacious mite, *Pediculoides ventricosus*, Newp., which destroyed large numbers of the immature stages of the moth. In view of the possibility of a repetition of such attacks, the adults of the mite are described and an account is given of its bionomics [*cf. R.A.E.*, A **14** 564], together with a list of the insects most commonly attacked by it, practically all of which are granary pests. The mite is introduced into the laboratories with grain infested by pests. It is recommended, therefore, that the grain should be disinfested by thoroughly wetting and then heating it at a temperature of 60–70°C. [140–176°F.] for an hour. It should be stirred during heating, and should afterwards be aired and dusted with sulphur at the rate of 1 part by weight to 500 parts grain.

[Skoblo (I. S.).] **Скобло (И. С.). The Effect of the environmental Conditions of the Pyralid Moth** *Loxostege sticticalis* **on the Viability of the deposited Eggs.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 153–157, 9 refs. Leningrad, 1939.

In the course of laboratory investigations in 1937 on the relation between feeding and fecundity in *Loxostege sticticalis*, L., it was found that the viability of the eggs was closely related to the nutrition of the parent females. Thus, when females were allowed to feed on 5 per cent. solutions of galactose, glucose or mannose, the percentages of the resulting eggs that did not hatch were 30·6, 14 and 10, respectively. The corresponding percentages were 9·6 and 32·3 for females fed on 1 and 25 per cent. solutions of saccharose and 5, 15·2 and 16·2 for those fed on 1, 10 and 25 per cent. glucose. Of eggs laid by females that were first starved and then allowed to feed uninterruptedly on a 25 per cent. solution of saccharose, 13·3 per cent. did not hatch, as compared with only 6·3 per cent. in the case of eggs laid by individuals that received the same solution only once in every 3 or 4 days. Preliminary data obtained by the author also indicate that the conditions of temperature and humidity prevailing during the life of the adults exercise a great effect on the viability of the eggs deposited.

[TZIOPKALO (V. L.).] **Циопкало (В. Л.). On Control Measures against the Spanish Fly** (*Lytta vesicatoria* **L.**). [*In Russian.*]—*Plant Prot.* no. 19 pp. 157–163, 1 fig. Leningrad, 1939.

In the Russian Union, protective strips of trees along the edges of fields are frequently attacked by adults of the Meloid, *Lytta vesicatoria*, L., which feed on the leaves, particularly of ash. Trees defoliated in two or more consecutive years gradually dry up and die. The beetles tend to concentrate on the edges of the strips, which facilitates their control by dusting from the ground. With a view to finding suitable insecticides, batches of 10 adults of both sexes were placed on bunches of ash leaves in cages measuring 12×12×16 ins. and various dusts were applied at rates varying from 1¼ to 200 mg. per cage.

Contact insecticides including a proprietary preparation, ground pyrethrum flowers containing about 0·5 per cent. pyrethrin I, and talc powder impregnated with pyrethrum extract were ineffective, but calcium arsenite, even at the rate of 5 mg. per cage (equivalent to about 1½ lb. per acre), gave complete mortality of males and females in 1·5 and 2·1 days, respectively. Sodium fluosilicate and sodium fluoride at rates of 40 and 60 mg. were effective against the males but did not kill all the females, possibly because the dusts were of poor quality. No scorching of the leaves occurred, except when calcium arsenite was used at the rate of 60 mg., which would be unnecessary in practice.

CAMERON (A. E.). **Insect and other Pests of 1938.**—*Trans. Highl. agric. Soc. Scot.* 1939 repr. 40 pp., 16 figs., many refs. Edinburgh, 1939.

Sawfly larvae observed defoliating 10-year-old trees of alder (*Alnus incana*) 15–20 ft. high in southern Scotland in September 1938 were identified as *Camponiscus luridiventris*, Fall., *Croesus septentrionalis*, L., *Nematus pavidus*, Lep., and *Nematinus luteus*, Panz. Since they are active only late in the season, the injury to the trees is slight. The larvae are briefly described and compared in a table, and characters are given distinguishing the adult of *C. septentrionalis* from those of the other three species.

Galls of *Rhyacionia resinella*, L., were found in considerable numbers on Scots pine [*Pinus sylvestris*] in a plantation near Edinburgh in October. The construction of the galls is described. The eggs of this Tortricid are laid in May and June on the shoot below the terminal whorl of buds or on the needle sheaths, and hatch in 2–3 weeks. The larvae immediately begin to form galls, from silk and resin, just below the terminal whorl of buds, overwinter in them, and enlarge them in spring, when the resin flow is most active. They feed on bark and wood on the surface of the twig, and hibernate again before pupating in their galls. The pupal stage lasts 4 weeks in May and June. The adults begin to emerge in May and are present for about two months. Infestation usually occurs on trees 6–10 years old growing in poor and scanty soil, though side branches of older ones may also bear galls. The leading shoot is seldom affected. The buds on the shoots are rarely destroyed, but under unfavourable climatic and soil conditions they may die, and trees planted on dunes may be seriously damaged, particularly if *R. turionana*, Hb., *R. buoliana*, Schiff., and *R. duplana*, Hb., are also present. Control measures, consisting in breaking off the galls or cutting the twigs below them, are necessary only in severe attacks or under unfavourable forest conditions.

Tortrix pronubana, Hb., all stages of which are briefly described, damaged the foliage of greenhouse flowering plants [*cf. R.A.E.*, A **12** 560] in eastern Scotland. The eggs are laid in masses of up to 200, usually on the upper surfaces of the leaves or on wood or glass. There are 2 overlapping generations a year, and the egg, larval and pupal stages last 2–3, 8–13 and 2 weeks, respectively. The larvae of the autumn generation overwinter and pupate on the food-plant in spring. Fumigation with nicotine or hydrocyanic acid gas is ineffective against the larvae, but tetrachlorethane and carbon bisulphide have been stated to give satisfactory control. Other measures [*cf.* **12** 561] include spraying the larvae with derris or pyrethrum before they are covered with webs. The spray should penetrate between the flowers and leaves at the ends of the shoots.

The roots of chrysanthemum shoots and cuttings in commercial glasshouses in central and southern Scotland have been damaged during every winter since 1932 by *Psila nigricornis*, Mg. The eggs are probably laid in the soil near the plants. The larvae burrow into the roots, reaching the base of the stem in young cuttings, and pupate in them or in the soil. In glasshouses, they feed throughout the winter and pupate in spring. The adults emerge during April and May, and are numerous on the flowers of umbelliferous garden plants in the open. *P. nigricornis* was recorded in January 1936 as attacking seedling lettuce under glass. Naphthalene dust, applied to the soil at intervals during spring and summer repels the adults, and watering the soil with 1 fl. oz. mercury bichloride in 10 gals. water kills the larvae. Beds that have contained infested chrysanthemums should be watered with mercury bichloride before being planted with lettuce. The buds and leaves of chrysanthemums in Peebleshire were injured in August and September by *Lygus pratensis*, L., notes on the bionomics and control of which are given [*cf.* **26** 709]. All weeds and refuse, in which the adults hibernate, should be destroyed. Garden flowers in south-eastern Scotland were damaged by *Mamestra brassicae*, L. All stages and its bionomics are briefly described. The larvae can be controlled by dusting infested plants with nicotine, nicotine sulphate, pyrethrum or derris.

Speyer (E. R.), Orchard (O. B.) & Read (W. H.). **Animal Pests.**—*Rep. exp. Res. Sta. Cheshunt* **24** (1938) pp. 64–86. Cheshunt, Herts., 1939.

Work at the Cheshunt Research Station during 1938 included further observations by Speyer on *Thrips fuscipennis*, Hal., as a pest of roses in greenhouses [*R.A.E.*, A **26** 711]. Eggs were usually deposited within the tissues of the bracts and stalks of young shoots and of the sepals of flower-buds or opening blooms, less often in the outer petals of opening blooms, only rarely in the leaves of young shoots, and never in older foliage or stems. Only fertile females enter hibernation in autumn, and during the hibernation period, which lasts 6–17 weeks, they do not become dormant even at temperatures considerably below freezing point, but are able to move and even fly if their immediate environment becomes excessively moist or otherwise unsuitable. In heated houses, a few remain amongst the leaves of young shoots and the petals, but they do not oviposit and feed only very little. Out-of-doors, they were found in the bark of chestnut, and also of hawthorn [*Crataegus*]. They could not be found on chestnut towards the end of March, and females containing mature eggs were collected from rose shoots at the beginning of April. Tests were accordingly made at this time with substances that were both deterrent and lethal. In tests on detached leaves, three days elapsed before derris powder caused appreciable mortality. A proprietary pyrethrum powder in which pyrethrum extract is absorbed upon a carrier caused paralysis in 10–20 minutes and total mortality within 2 days. The lethal action was lost in 24 hours in sunlight, but a deterrent action persisted for at least 3 days. A 1 per cent. solution of soft soap had no effect, but when nicotine (1 : 500) was added, total mortality resulted within 24 hours ; toxicity and deterrent action were lost within 48 hours. A spray of 2 lb. derris powder and 10 lb. soft soap in 100 gals. water on some occasions gave total mortality in 24 hours, but in others it failed to do so in 4 days. The soap caused the foliage to become yellowish. In a 4-acre block of houses, 7–11, 4 and 4 applications of the pyrethrum powder at 1 lb. to 2,000 sq. ft. for three successive crops resulted in almost the whole of each crop being uninjured, whereas during the preceding 5 years, they had been almost complete failures. The fourth crop appeared not to be attacked.

Speyer also reports that *Macrosiphum rosae*, L., on roses was controlled by pyrethrum powder and *M. sanborni*, Gill., on young chrysanthemum plants by a single application of a spray of 10 fl. oz. nicotine, 8 lb. soft soap and 100 gals. water. Larvae of *Brotolomia meticulosa*, L., were unusually abundant in greenhouses during the autumn and winter, when they caused much injury to flowers of chrysanthemum and the foliage of cineraria. Spraying chrysanthemum with 6 lb. lead arsenate paste in 100 gals. water is recommended up to 3 weeks before the blooms are ready for market. Derris dust prevented feeding for up to 4 days, but made the blooms unsightly and did not kill the larvae, which could withstand long periods of starvation. A dust of undiluted cryolite gave promising results. A very heavy infestation of *Agrotis* (*Triphaena*) *pronuba*, L., occurred in carnation houses in Hampshire at the end of October. The larvae defoliated the plants at night and remained buried in the ground during the day. They were killed by derris powder and by a poison bait consisting of 1 part Paris green and 28 parts bran moistened with 5–7 per cent.

treacle solution. An outbreak of *Tortrix pronubana*, Hb., occurred on *Cyclamen* and *Crassula* in Essex in the summer and became serious in the autumn, when larvae were also found on geranium at the experiment station. Orchard gives a brief report on control experiments. When the larvae were under their webs and lead arsenate could not be used because of the unsightly deposit, hand-picking was necessary. On plants without flowers, spraying with 10 oz. lead arsenate to 10 gals. water with ½ oz. saponin is recommended. If it is not necessary to wash off the deposit, the saponin should be reduced to ¼ oz.

Experiments by the same worker on the control of *Lygus pratensis*, L., on chrysanthemum, 50 per cent. of the blooms of which are sometimes rendered unfit for market by this Capsid, indicated that a proprietary dust containing sulphur, derris and nicotine was superior to others containing mainly derris or derris and nicotine, but its action is probably repellent. A spray containing nicotine gave good control when applied frequently during sunny periods. Two fumigations of chrysanthemum plants just brought into the house with Cyanogas calcium cyanide at ⅓ oz. per 1,000 cu. ft. did not injure the plants and killed the majority of the bugs. Lower concentrations gave no control and higher ones or treatment after the plants have been in the house some time scorches the leaves.

A synthetic wax emulsion [**25** 668] consisting of an emulsified solution of chlorinated naphthalene in benzene and used at a dilution of 1 : 160 (with a spreading agent if the spray was applied through a hand syringe) and an emulsion of dodecyl thiocyanate (lauryl rhodonate) [**26** 712] containing 0·17 per cent. active principle in the spray were compared by W. H. Read for the control of the red spider mite [*Tetranychus telarius*, L.] on carnations, and both gave good control of the mites and eggs without injuring the foliage except for slight spotting of very soft growth. The petals of open flowers were marked rather more by the wax emulsion than by the thiocyanate spray.

Speyer reports that tomato leaves containing mines of *Phytomyza* (*Liriomyza*) *solani*, Macq. [**25** 668; **26** 710] were received from Guernsey and Jersey. The pupae in one batch from Guernsey were heavily parasitised by Braconids. The insect was bred through three generations on tomato plants in pots during June–August, the larval and pupal stages lasting 3–6 and 13–18 days. Males and females lived for about 8 and 14 days, respectively. Many empty mines were found in October and no fresh ones occurred after the middle of this month. During August, plants standing outside became infested, and in October it was evident that a further partial generation had developed after they were housed in September, and that the pupae had gone into hibernation, mostly in the soil. The larvae of the June and August generations entered the soil to pupate, but most of those of the July generation pupated on the foliage. A bait-spray of 0·15–0·25 per cent. sodium fluosilicate and 2–2·5 per cent. sugar gave good kill of adults within 48 hours, and in only one instance was spray injury to the foliage recorded, but this method of control is not practicable in nurseries owing to the difficulty of determining the date when the majority of flies are likely to emerge. Adults of two other species of *Phytomyza* and of *Hylemyia* (*Delia*) *brunnescens*, Zett., were also attracted and killed by this bait-spray. Various other control measures were found to be ineffective. Experiments with nicotine sprays indicated that they are effective if nicotine is present in the proportion of at least 1 : 650. *Trypeta zoe*, Mg., was recorded in large numbers from chrysanthemum plants growing out-of-doors on 20th June. Several larvae appear to inhabit a single mine.

Tomatos in a greenhouse in which onions and melons had been grown earlier in the season were attacked by *Thrips tabaci*, Lind., in Scotland in October. The ripe fruit was speckled with yellow fleck-marks, and a short distance from the insertion of the calyx there was a complete ring of white, speckled with dark excrement. There were a few dead adults on the fruits, and considerable numbers among the sepals and on the stalks. Foliage showed only slight fleck-marks, but living adults were numerous on it though no immature stages could be found.

In experiments carried out by Read to determine whether derris for the control of *Polia oleracea*, L., on tomato could be added to the petroleum emulsion applied for the control of *Tetranychus telarius*, larvae a few days old were killed by the addition of derris extract equivalent to 0·002 per cent. rotenone to a 1 per cent. petroleum emulsion, and all except some mature ones by a spray containing 0·0045 per cent. rotenone, but 0·007 per cent. was necessary to give complete kill. Considerable loss of young cucumber plants in pots and mature plants in borders was caused in 1938 by outbreaks of *Plastosciara perniciosa*, Edw., and *Pnyxia scabiei*, Hopk. Read reports that in most cases, satisfactory control on young plants was obtained by drenching the soil with an emulsion of a sulphonated petroleum oil fraction containing 5 per cent. nicotine or a tar-acid emulsion, but these and other preparations were not satisfactory on cucumber beds.

MALENOTTI (E.). **I parassiti animali del frutteto.** [Animal Pests of Orchards.]—71 pp., illus. Rome, Ramo edit. Agricoltori, 1939. Price *Lire* 3.

This manual for fruit growers contains information on the morphology, bionomics and control of the commoner orchard pests in Italy, together with notes on the type of injury caused. Almost all the pests mentioned are insects.

MALENOTTI (E.). **Sui surrogati delle esche contro le grillotalpe.** [On Substitutes in Baits against Mole-crickets.]—*Giorn. Agric. Domenica* 1939 no. 27 repr. 2 pp. Rome, 1939.

It has been suggested that bran can be substituted for broken rice in baits poisoned with barium fluosilicate against mole-crickets [*Gryllotalpa gryllotalpa*, L.] in Italy [*R.A.E.*, A **20** 257]. The author describes experiments showing that wheat or maize bran was left untouched in the presence of broken rice. Mole-crickets may eat the bran on bare ground, but its attractiveness is not greater than that of young plants.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **10** no. 2 pp. 35–39, 14 refs. Suva, 1939.

In 1938, South American guava (*Psidium guayava*), which is regarded as a pest in plantations and grazing land in the Fiji Islands, was attacked by larvae of *Spilonota holotephras*, Meyr. [*cf. R.A.E.*, A **13** 88], which spun together the terminal leaves, checking the growth of the plants. This Tortricid has been found on Taveuni, Viti Levu and Vanua Levu. The eggs are laid in a compact mass, and the pupal stage lasts 7 days. The larvae are attacked by at least four Hymenopterous parasites, *Apanteles* sp., *Cremastus* sp., an Elasmid and

Tetrastichus sp. An Ichneumonid, *Mesochorus* sp., is assumed to be a parasite of one of the first three. The Tineid, *Setomorpha rutella*, Zell., and the Tortricid, *Adoxophyes fasciculana*, Wlk., also occur on guava but damage it much less than *Spilonota* does.

Termites taken in Suva in sapwood in 1932 and in a bedstead in 1937 were identified as *Calotermes brevis*, Wlk. The natural range of this species, which had not previously been recorded from Fiji [*cf.* **27** 641], extends from Mexico to British Guiana and the West Indies [*cf.* **25** 16 ; **27** 56]. Apart from a record in Natal, this appears to be the first notification of its occurrence outside the American region. It is a pest of some consequence of books and dry goods and also furniture and the woodwork of houses. As soon as attacks are noticed in wood, carbon bisulphide or paradichlorobenzene should be injected into the galleries. *Eutermes olidus*, Hill, was found established in the supporting posts of a suspension bridge on Vanua Levu in March 1939. This appears to be the first record of this species as a potential pest [*cf.* **27** 641].

Larvae of *Plutella maculipennis*, Curt., were intercepted in April 1939 in cabbages imported from Australia. Two parasites of *Agonoxena argaula*, Meyr., first bred in 1922 [**10** 439] are now known to be *Brachymeria fijiensis*, Ferrière, and *Apanteles* sp. A species resembling *Microbracon* (*Bracon*) *hebetor*, Say, and a species of *Eupelmus* were also bred from the larvae. *A. argaula* damaged coconut palms on Vanua Levu in October 1938, but was apparently checked by the parasites later in the season, and it was also reported on Makuluva Island in June 1939.

PAPERS NOTICED BY TITLE ONLY.

IMPERIAL INSTITUTE. **Quarterly Bibliographies on Insecticide Materials of Vegetable Origin, Nos. 4–8 (July 1938 to October 1939).**—*Bull. imp. Inst.* **36** no. 4 pp. 574–581 ; **37** nos. 1–4 pp. 65–72, 233–238, 405–412, 591–600. London, 1938–39. [*Cf. R.A.E.*, A **26** 694.]

[VOSKRESENSKAYA (A. K.).] **Воскресенская (А. К.). On the Principles of the Resistance of some Insects to Arsenic Insecticides.** [*In Russian.*]—*Plant Prot.* no. 19 pp. 132–144, 2 graphs, 7 refs. Leningrad, 1939. (With a Summary in English.) [*Cf. R.A.E.*, A **25** 155, 448.]

WIESMAN (R.). **Untersuchungen über die Struktur der Kuticula des Puppentönnchens der Kirschfliege,** *Rhagoletis cerasi* **L.** [Investigations on the Structure of the Cuticle of the Puparium of the Cherry Fly, *R. cerasi*.]—*Vjschr. naturf. Ges. Zürich.* **83** no. 3–4 Beibl. pp. 127–136, 4 figs., 12 refs. Zürich, 1938. [Recd. 1940.]

BÖVING (A. G.). **Descriptions of the three Larval Instars of the Japanese Beetle,** *Popillia japonica*, **Newm. (Coleoptera, Scarabaeidae).**—*Proc. ent. Soc. Wash.* **41** no. 6 pp. 183–191, 24 figs., 5 refs. Washington, D.C., 1939.

ANDRE (F.). **A Synopsis of the American Species of** *Chirothrips* **Haliday (Thysanoptera).**—*Proc. ent. Soc. Wash.* **41** no. 6 pp. 192–204, 10 figs., 4 refs. Washington, D.C., 1939.

CLEARE (L. D.). **The Amazon Fly (***Metagonistylum minense*, **Towns.) in British Guiana.**—*Agric. J. Brit. Guiana*, **10** no. 2 pp. 55–77, 1 fig., 1 pl., 19 refs. Georgetown, 1939. [Reprint, see *R.A.E.*, A **27** 505.]

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Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.

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